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The associations between cooking and gardening behaviors and determinants of behavior with dietary intake and obesity in low-income, Hispanic youth

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by

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Dedication

This work is dedicated to:

My mother and father who have provided endless, unconditional love and support since the day I was born. They have believed in me and pushed me to be the best version of myself that I can possibly be. They instilled in me a love for learning at an early age, for which I could not possibly be more grateful.

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The associations between cooking and gardening behaviors and determinants of behavior with dietary intake and obesity in low-income, Hispanic youth

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Childhood obesity and obesity-related diseases are major problems in the United States and disproportionately affect Hispanic youth and children from low socioeconomic status households. This population has limited access to fresh fruits and vegetables, and consumption of fruits and vegetables have been shown to prevent weight gain and may reduce the risk of obesity. Current literature shows that cooking and gardening are associated with increased fruit and vegetable preferences and intake. School cooking and gardening programs show promise in improving dietary intake in children. The purpose of this cross-sectional research was to identify associations between cooking and gardening behaviors and determinants of behavior (attitudes, self-efficacy, and motivation) and subsequent fruit and vegetable intake in low-income, minority youth who participated in school-based cooking and gardening interventions. The first aim was to examine the association between changes in cooking and gardening behaviors and determinants of behavior with changes in dietary fiber intake, vegetable intake, body mass index (BMI), and waist circumference in participants of the LA Sprouts randomized controlled intervention. The second aim was to examine the baseline relationship between child cooking involvement and parental support in food preparation with vegetable exposure, vegetable preference, vegetable intake, and BMI from participants of the

Texas! Grow! Eat! Go! group-randomized controlled intervention. The third aim was to examine the baseline relationship between cooking and gardening behaviors and determinants of behavior (attitudes and self-efficacy) with fruit and vegetable intake in participants of the TX Sprouts randomized controlled intervention. All analyses were conducted using data from primarily low-income and Hispanic youth. The results of this research demonstrated that cooking and gardening behaviors and determinants of behavior are positively associated with fruit and vegetable intake in this population, suggesting that improving cooking and gardening skills and determinants of behavior in children through school cooking and gardening programs may be an effective means to improve their dietary intake.

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List of Abbreviations

ANCOVA – Analysis of Covariance
BMI – Body Mass Index
CATCH – Coordinated Approach to School Health
CCI – child cooking involvement
CG – cooking and gardening
CSH – coordinated school health
CVD – cardiovascular disease
CWK – Cooking With Kids
DF – dietary fiber
FV- fruit and vegetables
G – gardening
GHK – Growing Healthy Kids
JMG – Junior Master Gardener
LA's BEST – Los Angeles' Better Educated Students for Tomorrow
LGEG – Learn! Grow! Eat! Go!
LAUSD – Los Angeles Unified School District
MF – frequency of child making food with family
NE – nutrition education
PS – parental support in food preparation
RCT – randomized controlled Trial
RHS – Royal Horticultural Society
SD – standard deviation
SES – socioeconomic status
SPAN – School Physical Activity and Nutrition
T2D – type 2 diabetes
TGEG – Texas! Grow! Eat! Go!
US – United States
VP – vegetable preference
WAT – Walk Across Texas
WC – waist circumference
Y – years

Chapter 1: Introduction & Literature Review

Childhood Obesity, Obesity-Related Diseases, and the Hispanic Population

Childhood obesity is a major concern in the United States (US), as it affects 17.5% of US children between the ages of 6 and 11[1]. Children who are obese are more likely than their normal weight counterparts to exhibit cardiovascular disease (CVD) risk factors such as high blood pressure and increased triglycerides[2]. In a large sample from the Bogalusa Heart Study, 70% of obese youth between ages 5 and 17 exhibited at least one risk factor for CVD[3]. Childhood obesity is also linked with an increased risk for a multitude of health problems in childhood such as bone and joint problems, sleep apnea, social and psychological problems, asthma, high blood pressure, and abnormal fasting glucose[1,2,4]. Obesity in childhood is also correlated with obesity in adulthood, which is associated with an increased risk for many diseases and health conditions, including CVD, type 2 diabetes (T2D), stroke, cancer, non-alcoholic fatty liver disease, and arthritis[5–7]. Additionally, obesity in adulthood is linked with increased morbidity and mortality[1].

Hispanic youth between the ages of 6 and 11 are affected by obesity at a disproportionately higher rate, with 25% being obese compared with 13.6% of non-Hispanic white children of the same age group[1]. Hispanics are also affected by obesity-related diseases including heart disease, metabolic syndrome, non-alcoholic fatty liver disease, and T2D at a disproportionately higher rate than non-Hispanic whites[7–9].

Lower socioeconomic status (SES) is associated with higher rates of obesity in American youth, and low-income and minority children are disproportionately affected

by obesity-related health problems[10–12]. It is crucial to decrease obesity and metabolic disease risk in high-risk populations. Thus, interventions targeting reducing obesity and metabolic disease risk in Hispanic youth are warranted.

Fruit, Vegetables, Dietary Fiber and Their Beneficial Effects on Health and Obesity

Fruits and vegetables have been shown to be inversely associated with weight gain and may be effective preventing obesity and adiposity[13–16]. Fruit and vegetable consumption is also associated with a reduction in risk for T2D, visceral fat, liver fat, and insulin resistance in Hispanic youth[17,18]. The consumption of fruits and vegetables has been linked with reduced risk for a multitude of chronic diseases including CVD, high blood pressure, stroke, rheumatoid arthritis, asthma, and numerous types of cancer[19,20]. Fruit and vegetable intake is inversely associated with mortality, and it has been shown that a fruit and vegetable intake of less than three servings per day is responsible for 5.6 million premature deaths per year[21,22]. Additionally, a lack of fruit and vegetable consumption in childhood predicts subsequent development of obesity[23]. Fruit and vegetable intake is an essential part of a child's diet and is crucial for maintenance of health and prevention of disease.

Dietary fiber has also been shown to be extremely beneficial to health and disease prevention. It is inversely associated with obesity parameters including waist circumference and visceral fat in Hispanic youth[24,25]. Dietary fiber intake is also linked to improvements in the metabolic syndrome, reductions in T2D risk factors, and decreased inflammation in this population[15,24,26]. Children in the US have poor diet quality and do not meet the recommended intake for fruit, vegetable or dietary fiber intake, with intake

being even lower in low-income and Hispanic populations due to limited access to affordable and fresh fruits and vegetables[9,27,28]. The diets of children in the US typically contain high amounts of desserts, pizza, and sugar-sweetened beverages and low amounts of fruits, vegetables and whole grains[10]. The average fruit and vegetable intakes among children (9-13 years) are 0.7-cup equivalents and 1-cup equivalent, respectively, which is substantially less than the recommended intake of 1.5 cup equivalents of fruit and 2-2.5 cups of vegetables per day for this age group[29–31]. Ninety percent of children also do not meet the recommendations for dietary fiber, and they are, on average, consuming less than half of what is recommended, which is 26 and 31 grams for females and males, repsectively[25,32–34].

Because low SES populations often reside in food deserts in which there is limited access to fresh fruits and vegetables, it is even more difficult for this population to consume these healthful foods[35]. To complicate the issue further, the cost of fresh fruits and vegetables has increased at a faster rate than high-fat and high-sugar foods, adding to the burden of eating fruits and vegetables while making it easier to access, purchase, and consume unhealthy, processed foods[36].

Interventions that target increasing both the availability of fresh fruits and vegetables and dietary-fiber rich foods as well as subsequent intake of these foods are warranted in order to reduce obesity and metabolic disease risk, especially in low-income, Hispanic populations.

DETERMINANTS OF DIETARY BEHAVIOR

Increased exposure to a food is associated with increased preference for that food, and it has been shown that children who are exposed to fruits and vegetables have a

greater likelihood of eating them than those who are not exposed[37,38]. It has also been shown that children do not like vegetables, so it is crucial to expose children early on in life to healthy foods such as fruits, vegetables, and other foods that are rich in dietary fiber in order to improve their preferences for these healthy foods[39]. Children's preference for vegetables predicts their vegetable consumption, so exposure to fruits and vegetables, specifically early in life, may lead to increased preference for and subsequent consumption of fruits and vegetables in childhood and into adulthood[40,41]. Because of the strong impact of fruit, vegetable, and dietary fiber consumption on obesity and obesity-related diseases, it is imperative to increase exposure to and, therefore, preference for and consumption of fruits and vegetables in children, especially in high-risk populations.

Social Cognitive Theory is one of the main theories used to explain behavior and is based on the idea that self-efficacy and expectation of the outcome are key predictors of subsequent behavior[42]. Another related theory used to explain behavior is the Self-Determination Theory, which posits that people have three intrinsic needs: competence, relatedness, and autonomy. This theory suggests that in order for a particular behavior to occur, the child must feel capable of doing the behavior, that others can relate to this behavior, and the child must also feel that he or she is the reason for doing the behavior (rather than an external motivation)[9].

In children, numerous factors from these three theories have been identified as predictors of fruit and vegetable intake such as knowledge, preference, self-efficacy, attitudes towards fruits and vegetables, and willingness to try fruits and vegetables[9]. It is imperative to improve these determinants of dietary behavior in children, especially high-

risk children, as a means to get them to eat more fruits and vegetables and adopt healthier habits that may last into and through adulthood.

It is essential to teach healthy habits from a young age and make healthy foods available and accessible to children, as it has been shown that food choices and habits that persist through adulthood are typically set in place by the time a child reaches the age of 15[43]. Additionally, childhood is the best time to promote learning of skills that last through adulthood[44].

COOKING AND DIETARY INTAKE

Cooking and meal preparation skills are essential to improving dietary intake, and a lack of these skills is one of the main barriers to consumption of healthful foods[45]. One study conducted in 47 low-income, minority women showed that a lack of food preparation skills made participants feel as though they were limited in which fruits and vegetables they could purchase at the grocery store.[46] Similarly, a lack of cooking skills is associated with decreased purchasing, preparation, and consumption of fruits and vegetables[47]. Cooking at home is associated with increased fruit and vegetable intake and a higher-quality diet, and a dislike for cooking is associated with increased fast food consumption[44]. Additionally, eating away from home has been linked with decreased consumption of fruits and vegetables[10]. Children who are more involved with cooking at home eat more fruits and vegetables than those who are not involved. One study conducted in 3,398 elementary school children found that children who participated in meal preparation at home ate one more serving of fruits and vegetables than children who did not participate[48]. Another study involving children between the ages of 6 and 10 showed that children who helped their parent prepare a meal including pasta with breaded

chicken, cauliflower, and a salad ate 76% more salad at the subsequent meal than the children who did not help[49]. It is crucial to equip children with cooking skills and get them involved in meal preparation so that they do not experience these barriers to consuming fruits and vegetables both in childhood and as they transition into adulthood.

GARDENING AND DIETARY INTAKE

Gardening and growing fruits and vegetables has also been shown to positively influence food preferences and dietary intake[50]. In a cross-sectional analysis of 1,121 college students, it was found that students who currently garden and students who gardened in childhood ate significantly more fruits and vegetables than those who had never gardened. The researchers also found that frequency of gardening was positively associated with fruit and vegetable intake[22]. A home gardening intervention was conducted in which gardens with seasonal vegetables were planted at each of the 42 adult participants' homes. They were given all gardening supplies as well as access to master gardeners to help maintain their gardens. Researchers assessed change in fruit and vegetable intake of participants over the course of one year and found that participants increased fruit and vegetable intake by one serving per day[51]. Gardening is associated with increases in fruit and vegetable intake and appears to be a worthwhile activity to get people involved in as a means to improve their dietary intake, however a few studies show no beneficial effects[52].

COOKING AND GARDENING INTERVENTIONS AS A WAY TO IMPROVE DETERMINANTS OF DIETARY BEHAVIOR, DIETARY INTAKE AND HEALTH

School-based cooking and gardening interventions are becoming a popular tool to teach children about nutrition and the importance of fruits and vegetables as well as in improving dietary intake, however the cooking and gardening strategies vary widely among these programs, and not all of them show positive effects on fruit and vegetable intake[19,29,35,43,52–66]. Some are cooking only, some are cooking and gardening, and some are gardening only, but most successful interventions include some sort of hands-on approach that involve children in either the planting and growing of fruits and vegetables and/or the tasting of/preparation of the produce. Not only do children have a better understanding of foods and how these foods relate to health after participating in first-hand gardening experiences, they also enjoy working, preparing fruit and vegetable snacks, and learning about fruits and vegetables in the garden[58,61]. Additionally, direct involvement in growing fruits and vegetables is linked with improvements in healthy eating attitudes and preferences[58].

Numerous cooking and gardening interventions have proven to be effective at increasing fruit and vegetable preference and intake. See **Table 1.1** for a complete literature table highlighting the design, methods and results of the existing cooking and gardening interventions and cross-sectional analyses conducted between 2000 and 2018.

For example, one school garden-based nutrition intervention conducted in 99 sixth grade students demonstrated that students who participated in garden-based activities increased their fruit and vegetable intake as well as fiber, vitamin A, and vitamin C intake compared with controls[56]. Similarly, a three-year prospective cooking and gardening

intervention delivered to 327 4th and 5th grade students found that students who were most exposed to these programs increased fruit and vegetable consumption by 0.5 cups, while students least exposed decreased fruit and vegetable consumption by 0.3 cups[57]. In this study, schools differed in their implementation of the intervention, as staff and administration of each school were in charge of their own implementation. Interviews were conducted throughout the course of the intervention to determine degree of implementation at each of the schools. The criteria included in the assessment of degree of implementation were as follows: school food (availability of fresh, appealing meals), school dining (whether or not there were tables and chairs for a sit-down meal), garden classes (from 0-24 hours of instruction by a paid or volunteer teacher) cooking classes (from 0-24 hours of instruction by a paid or volunteer teacher), and lesson integration (whether core subjects were integrated into the cooking and/or gardening classes). Schools were categorized as high, medium, or low implementation based on the previously listed assessment criteria.

Duncan et al. conducted an intervention in 77 children (average age of 9 years; 46 in the intervention group and 31 in the control group) that consisted of a 12-week school gardening program in which students were involved in the planting, weeding, and harvesting of produce. They received nutrition lessons weekly and participated in taste tests from the garden throughout the intervention period. Children in the intervention group ate significantly more fruit and vegetables than controls after the intervention[67].

Another study conducted in elementary school students utilized container gardening in the classroom over the course of one school year. Students planted and tended to their indoor garden and some teachers implemented in-class taste tests. The school also

implemented a healthy snack program during four months of the intervention during which one raw fruit or vegetable was given to the students each week. Students significantly improved their fruit and vegetable preference between baseline and post-intervention, however no improvements in consumption were observed[65].

Ratcliffe et al. implemented a garden-based nutrition intervention in 320 low-income students in sixth grade over a 13-week period. Students planted, watered, and tended to the garden and ate vegetables from the garden at least three times. They also cooked meals using fruits and vegetables from the garden at least four times. They found that students in the intervention group had increases in attitudes towards, preferences for, and willingness to try vegetables. Participants also ate a larger variety of vegetables compared to controls[64].

In addition to improvements in dietary intake, a few cooking and gardening interventions have also resulted in reductions in obesity parameters. Our lab recently completed a 12-week after-school gardening, cooking, and nutrition randomized controlled intervention called "LA Sprouts" that was delivered to 319 primarily low-income Hispanic third through fifth grade students in the Los Angeles area. The LA Sprouts intervention was effective in decreasing body mass index (BMI) and waist circumference in addition to increasing dietary fiber and vegetable intake[68]. Similarly, the Growing Healthy Kids 7-week community garden intervention involved weekly gardening, cooking, and nutrition workshops with 95 primarily Hispanic children (2-15 years of age) and resulted in increased fruit and vegetable intake and 17% of the obese or overweight participants had significant reductions in BMI[53].

In the Texas! Grow! Eat! Go! pilot intervention, researchers observed similar results. The intervention was delivered during the spring of 2012 to 62 primarily low-income and Hispanic parent and child dyads, and the analysis included the 44 children and 34 parents with complete pre- and post-intervention data. Participants were involved in two programs over the course of the intervention – the Junior Master Gardener program, which is a gardening and nutrition education program that includes vegetable taste tests and the Walk Across Texas program in which participants are encouraged to walk as a part of their daily physical activity. In addition to increases in vegetable preference and consumption, the study also demonstrated increases in preference for gardening between the start and end of the intervention. At the start of the study, 57% of the participants were obese, and only 39% were obese at the conclusion of the intervention[66].

Similar effects have been observed with cooking-only interventions. A cooking-only, semester-long intervention disseminated in low-income, Hispanic fourth grade students showed increases in vegetable consumption as well as increases in cooking attitudes and self-efficacy[69]. In an experiment conducted in 47 elementary school children, the child was assigned to either the "child cooks" condition, in which the child assisted the parent in preparing lunch or to the "parent cooks" condition in which the parent prepared lunch alone. Participants in the "child cooks" condition ate significantly more vegetables than those in the "parent cooks" condition[49].

These results in addition to those displayed in **Table 1.1** highlight the numerous cooking and gardening interventions that are effective at increasing fruit and vegetable preference and intake and show promise in reducing obesity and related metabolic disease risk in children.

Table 1.1: Cooking and Gardening Literature Search

Reference	Subjects	Methods	Results
Cooking & Gardening Programs			
Castro et al.[53] *American Journal of Preventative Medicine, 2013* Growing Healthy Kids (GHK) Pilot	▪ N=95 ▪ Ages 2-15 years ▪ Primarily low-income Hispanic	▪ Community intervention ▪ Weekly gardening session ▪ 7-week cooking and nutrition program ▪ Social events for parents and children ▪ BMI determined ▪ Measures compared pre to post-intervention data	▪ By the end of the program, 17% of overweight/obese children improved BMI classification ▪ 146% increase in availability of fruit and vegetables (FV)* ▪ 28% increase in fruit consumption* ▪ 33% increase in vegetable consumption* *In GHK participants compared with controls
Gibbs et al.[54] *Journal of Nutrition Education and Behavior, 2013* Stephanie Alexander Kitchen Garden Program	▪ N=764 ▪ 3rd – 6th grade children ▪ Ages 8-12 years ▪ 6 program schools & 6 control schools (matched for SES and size)	▪ 45-60 minutes in garden class each week ▪ 90 minutes in kitchen class each week ▪ Intervention vs. control	▪ Increase in child's willingness to try new foods ▪ No significant changes in intake, but qualitative evidence showed improvements in healthy eating (parent focus groups)

Table 1.1, continued

Wang et al.[57] *Journal of Adolescent Health, 2010*	▪ N=327 ▪ 4th & 5th grade students	▪ Weekly gardening intervention (3 years) including cooking, gardening, and nutrition education ▪ Exposure to intervention varied ▪ Most exposed to program compared to least exposed ▪ 3-day food diary, questionnaires ▪ Pre/post test	▪ Increase in FV intake (0.5 cups)* ▪ Increase in fruit preference* ▪ Increase in preference for green leafy vegetables* *In those most exposed to program compared to least exposed
Gatto et al.[35] *Pediatric Obesity, 2016* LA Sprouts	▪ N=319 ▪ 3rd – 5th grade students	▪ Cooking, gardening, nutrition program (12 weeks) ▪ Pre/post test ▪ Intervention vs. control	▪ Reduction in BMI ▪ Reduction in waist circumference ▪ Increase in FV intake ▪ Increase in dietary fiber intake
Heim et al.[61] *Journal of the American Dietetics Association, 2009*	▪ N=93 ▪ 4th – 6th grade students	▪ Gardening, FV taste tests, FV snack preparation (12 weeks) ▪ Pre/post test ▪ Intervention vs. control	▪ Increase in FV intake ▪ Increase in vegetable preference ▪ Increase in FV asking behavior at home ▪ High level of enjoyment
Duncan et al.[67] *Journal of Health Psychology, 2015*	▪ N=77 ▪ Mean age of 9 years	▪ 1 intervention school, 1 control school ▪ 12-week school garden intervention that included creating a school garden with cooking & gardening curriculum	▪ Intervention group increased FV consumption ▪ Intervention group increased intentions, attitudes, norms, and perceived behavioral control towards FV consumption ▪ Attitudes, norms, and perceived behavioral control were predictors of changes in FV consumption

Table 1.1, continued

Spears-Lanoix et al.[66] *Childhood Obesity, 2015* Texas! Grow! Eat! Go! (TGEG) Pilot	▪ N=34 student-parent dyads ▪ 3rd grade students & their parents	▪ Junior Master Gardener (JMG) & Walk Across Texas (WAT) interventions implemented (JMG for 5 months, WAT for 8 weeks during those 5 months) in 3 classrooms ▪ Baseline and post-test data obtained ▪ No control group	▪ Significant changes in student knowledge, vegetable preferences, vegetable consumption, and home food availability ▪ Significant changes in child weight status (reduction in obesity) & increase in physical activity
Koch, Pamela[70] *Journal of Nutrition Education and Behavior, 2015*	▪ N=300 ▪ K-8th grade students	▪ One-year seed to table gardening and kitchen classroom education + cafeteria scratch-cooked meals program ▪ Evaluated FV intake at lunch	▪ Increase in students who ate at least some cooked vegetable (13.9% vs. 36.1%) ▪ Increase in students who took from salad bar (0.3% vs. 5.5%) ▪ Increase in students who consumed fruit (24.6% vs. 46.5%)
Evans et al.[71] *Health Promotion Practice, 2012*	▪ N=246 ▪ Adolescents (59% Hispanic, 70% low-income) ▪ 5 middle schools (diverse ethnicities)	▪ 6 components: 1) in-class lessons 2) after-school gardening 3) farm-to-school (cafeteria component – locally grown produce incorporated into school menus) 4) farmers' visits to schools 5) taste testing 6) field trips to farms ▪ Intervention vs. control; analyses at post-test only	▪ Students exposed to 2 or more components of intervention had higher FV intake, self-efficacy for FV consumption, and knowledge of FV ▪ Also scored lower on preference for unhealthy foods ▪ Farmers' visits to schools, taste testing, and farm-to-school had largest effect sizes (but not significant)

Table 1.1, continued

Gardening Only			
Loso et al.[22] *Journal of the American Dietetics Association, 2017*	▪ N=1,121 ▪ College freshman from 8 US universities	▪ Participants filled out the National Cancer Institute FV screener and answered questions about gardening experiences ▪ Groups: 1) gardened during childhood or not and 2) garden now or not ▪ Linear mixed model used to relate childhood and recent gardening to FV intake	▪ Participants who gardened during childhood and recently had higher FV intake than those that had never gardened ▪ FV intake was positively correlated with frequency of recent gardening
Jaenke et al.[74] *Health Education & Behavior, 2012*	▪ N=127 ▪ 11-12 year olds in Australia	▪ Nutrition education (NE) only group, NE + gardening (G) group, and control group ▪ 10 week program ▪ Pre and post-intervention (6 weeks) outcomes measured by dietary recalls & 5-point smiley scales	▪ Willingness to taste increased in NE+G and NE group compared to control ▪ Also increased in NE+G compared to NE ▪ Girls in NE group increased fruit intake more than NE+G and controls ▪ Boys in NE+G group amore willing to taste vegetables compared with NE & controls (approached significance for girls) ▪ No change in vegetable intake

Table 1.1, continued

Cotugna et al.[73] *Jounral of Hunger & Environmental Nutrition, 2012*	▪ N=359 ▪ 4th & 5th grade students in Delaware	▪ Hands-on gardening program in two schools/no gardening program in one school ▪ Salad served at lunch ▪ Salad then made using garden produce at lunch	▪ Percentage of children who chose salad at lunch increased when it was made with produce from the garden post-intervention (significant increase in intervention groups only)
Triador et al.[65] *Journal of Nutrition Education and Behavior, 2015*	▪ N=76 ▪ 1st – 6th grade students ▪ Conducted in Aboriginal First Nations	▪ 7-month gardening and 4-month FV snack program ▪ EarthBoxes were assembled by students and contained seeds of 10 different vegetables ▪ Students planted contents in their classrooms under grow lights ▪ FV snack program – school chef distributed 14 different FV	▪ Increase in FV preference ▪ No change in consumption
Namenek et al.[19] *BMC Public Health, 2013*	▪ N=76 ▪ Preschoolers (average of 19 students per center)	▪ 2 intervention centers/2 control centers ▪ Intervention = FV garden, monthly curriculum, gardening support ▪ Measured child's consumption of FV before and after the intervention	▪ Intervention children consumed more vegetables than controls, but controls consumed more fruit

Table 1.1, continued

Christian et al.[62] *International Journal of Behavioral Nutrition and Physical Activity, 2014*	▪ N=641 ▪ 3rd – 6th grade students	▪ 23 schools randomized into 2 groups: o Royal Horticultural Society (RHS) –led intervention (more intense) o Teacher-led intervention (less intense) ▪ School gardening program ▪ Dietary assessment using CADET questionnaire pre- and post-intervention (18 months)	▪ FV intake in teacher-led group was higher, but significance disappeared after adjusting for confounders ▪ Improvement in school's gardening involvement (range from 0 [no garden] to 5 [community involvement] led to increase in FV consumption regardless of treatment group
Parmer et al.[60] *Journal of Nutrition Education and Behavior, 2009*	▪ N=115 ▪ 2nd grade students	▪ Gardening and nutrition education group vs. nutrition education only group vs. control (28 weeks) ▪ Pre/post test	▪ Increase in nutrition knowledge* ▪ Increase in taste ratings* ▪ More likely to consume vegetables in a lunchroom setting** *In both gardening and nutrition education group and nutrition education group compared with controls **In gardening and nutrition education group compared with both other groups

Table 1.1, continued

Hutchinson et al.[52] *Appetite, 2015*	▪ N=641 ▪ 3rd – 6th grade students	▪ 23 schools randomized into 2 groups: o Royal Horticultural Society (RHS) –led intervention (more intense) o Teacher-led intervention (less intense) ▪ School gardening program ▪ Dietary assessment using CADET questionnaire pre- and post-intervention (18 months)	▪ Teacher-led children more likely to agree they ate lots of fruit and tried new fruit ▪ RHS-led group associated with increase in vegetables recognized
Wright & Rowell[72] *Wisconsin Medical Journal, 2010*	▪ N=234 ▪ Kindgergarden-5th grade students (50% on free/reduced lunch)	▪ School-wide gardening program for 73 school days – planting, harvesting, tasting ▪ School's salad bar was used to measure changes in vegetable consumption at lunch	▪ Data collected for 10 weeks before intervention – during this period, selection of vegetables from salad bar decreased ▪ During intervention period, vegetable selection from salad bar increased and continued to show a slight rise post-intervention

Table 1.1, continued

Morgan et al.[55] *Public Health Nutrition, 2010*	▪ N=127 ▪ 5th and 6th grade students ▪ Ages 11-12 (54% male)	▪ Quasi-experimental 10-week intervention ▪ Groups: 1) nutrition education + gardening (NE+G) 2) NE only and 3) control	▪ NE+G and NE groups increased willingness to try vegetables and increased taste ratings of vegetables ▪ NE+G group exhibited increased ability to identify vegetables, willingness to taste certain vegetables (capsicum, broccoli, tomato, and pea) and preference to eat broccoli compared to both other groups
Morris et al.[58] *Journal of the American Dietetics Association, 2002*	▪ N=213 ▪ 4th grade students	▪ 9 lessons every other week for 17 weeks for nutrition + gardening group (NG) ▪ NL group – nutrition in classroom only ▪ Control received no intervention ▪ Pre/post test ▪ 6-month follow-up	▪ Willingness to try higher in NL & NG groups compared with control ▪ Higher preference for carrots & broccoli in NL & NG groups compared with control ▪ Higher preference for snow peas & zucchini in NG group compared with both other groups* ▪ No significant changes in FV intake *After 6 months, only NL group retained carrot preference and only NG retained broccoli, snow peas, and zucchini preference

Table 1.1, continued

Lineberger & Zajicek[43] *HortTechnology, 2000*	▪ N=111 ▪ 3rd & 5th grade students from 5 Texas elementary schools	▪ Nutrition in the Garden lessons (horticulture + nutrition information) ▪ 34 (20 minute) activities; ▪ Pre and post questionnaire ▪ 24-hour dietary recall	▪ More positive attitudes towards vegetables after intervention ▪ More positive attitudes towards consuming FV as a snack ▪ No change in FV intake
Somerset & Markwell[59] *Public Health Nutrition, 2008*	▪ N=252 ▪ 4th- 7th grade students ▪ Low SES area in Australia	▪ Introduction of school-based food garden ▪ Teacher coordinator hired for 11 hours/week to facilitate integration of garden activities into curriculum ▪ Intervention vs. control	▪ Improved ability to identify individual FV ▪ Increase in perceived FV consumption ▪ Increase in confidence in preparing FV snacks ▪ Decreased interest in trying new fruits
Ratcliffe et al.[64] *Health Promotion Practice, 2011*	▪ N=320 ▪ 6th grade students (2 intervention schools, 1 control school) ▪ 7% white, 35% overweight, 64% low-income	▪ Quasi-experimental; pre-post measurements ▪ Garden-based learning sessions integrated into school schedule ▪ 4 months, 1 hour a week ▪ 20 minutes of instruction; 40 min hands-on experience in garden ▪ Vegetable frequency questionnaire and taste tests	▪ After gardening intervention, better able to identify vegetables than control ▪ Increased preference for vegetables ▪ Increased willingness to try vegetables ▪ Increase in variety of vegetables consumed more than once a month

Table 1.1, continued

McAleese & Rankin[56] *Journal of the American Dietetics Association, 2007*	▪ N=99 ▪ 6th grade students	▪ Gardening and nutrition education vs. nutrition education only vs. control (12 weeks) ▪ Pre/post test	▪ Increase in FV intake* ▪ Increase in Vitamin A, Vitamin C, and dietary fiber* *In gardening and nutrition education group vs. both other groups
Cooking Only			
Cunningham-Sabo & Lohse[69] *Childhood Obesity, 2013* Cooking With Kids (CWK)	▪ N=257 ▪ Students in 12 4th grade classes ▪ Non-Hispanic white ▪ 54% girls ▪ 79% had previous cooking experience	▪ 1-hour introductory cooking lesson ▪ Three 2-hour cooking classes ▪ 3 1-hour FV tasting sessions ▪ Led by trained food educators for one semester (during school hours) ▪ FV preference, cooking attitudes, cooking self-efficacy assessed	▪ CWK students increased vegetable preference, cooking attitudes, and cooking self-efficacy
Caraher et al.[75] *Appetite, 2012*	▪ N=169 ▪ 4th & 5th grade students	▪ Cooking classes with local chefs (3 sessions) ▪ Intervention vs. control	▪ Increase in vegetable intake ▪ Increase in confidence to prepare FV

Table 1.1, continued

Chu et al.[48] *Journal of Nutrition Education and Behavior, 2013*	▪ N=3,398 ▪ 5th grade students	▪ Food frequency questionnaire/diet quality assessed ▪ Children asked "How often do you help prepare or cook food in your home?" Response options: never/almost never, once per month, 1-3 times per week, once per day, several times per day; from Project EAT questionnaire	▪ Children involved in daily meal prep ate 1 more serving of FV per day than children not involved
Van Der Horst et al.[49] *Appetite, 2014*	▪ N=47 ▪ 6-10 year olds	▪ Condition 1: children prepared lunch meal with parent ▪ Condition 2: parent prepared lunch meal alone	▪ Children in Condition 1 ate 76.1% more salad ▪ Also reported increased positive feelings and feeling in control

Brown et al.[76] *Journal of Nutrition Education and Behavior, 2005*	▪ N=229 children, N=373 adults ▪ Average age of children =12 ▪ Average age of adults =57 ▪ From 28 counties in Oklahoma	▪ 8 cooking classes that taught basic FV prep skills, food safety, and nutrition information ▪ Pre vs. post questionnaire	▪ Both youth and adults increased FV intake after program ▪ Adults increased from 1.1 to 2.3 and children increased from 1.5 to 2.1 servings of fruit per day ▪ Adults increased from 2.1 to 2.7 and children increased from 1.4 to 2.4 servings of vegetables per day ▪ 69% of youth and 48% of adults reported eating a new fruit or vegetable

Table 1.1, continued

Fulkerson et al.[77] *Obesity, 2010*	▪ N=44 ▪ Children (ages 8-10) and their parents ▪ 84% Caucasian	▪ Intervention group: five 90-minute lessons including taste testing, cooking skill building, and hands on meal preparation ▪ Control group: no intervention ▪ Pre and post-intervention and 6-month follow up measured using dietary recalls	▪ Trending toward significant increase in FV intake (p=0.08) ▪ Children in intervention reported greater food prep skill development

Allirot et al.[78] Appetite, 2016	▪ N=137 ▪ Children (ages 7-11) from Spain	▪ Cooking workshop group ▪ Control group ▪ After the workshop, children chose between 3 familiar vs. unfamiliar foods for a snack ▪ Willingness to choose and taste, liking, and intake was assessed	▪ Cooking workshop group: o Chose more unfamiliar foods and were more willing to taste unfamiliar foods o Greater liking of 2 of the 3 unfamiliar foods

ROLE OF THE PARENTS

Parents play a key role in determining a child's dietary intake, as they are the main purchasers of groceries in the home[10,79]. Numerous parental behaviors including preparing meals with their child as well as making fresh fruits and vegetables available to their children in the home are linked with improvements in the child's fruit and vegetable intake[79,80]. Parental fruit and vegetable intake is another a predictor of the child's fruit and vegetable intake[81]. It has also been shown that children's diets and relationship with food as they grow up and live independently tend to mimic that of their parents[82].

Cooking and gardening programs in school have been shown to be successful in getting both the child and parent involved in these behaviors, especially in high-risk, minority populations[79]. Although parents do the purchasing of groceries for the home, children play a role in the types of foods parents purchase, whether or not the family will eat together, as well as how often the family eats fast food[10].

Involving parents in school-based cooking and gardening interventions is an important factor in the success of these interventions to encourage the children to implement the healthy habits they have learned in school once they are at home.

BARRIERS TO COOKING AND GARDENING PROGRAM IMPLEMENTATION

Cooking and gardening can be labor-intensive and costly, and the main issue with implementing these programs into the school setting once the intervention period has ended is that it is difficult to convince teachers and the administration to get on board, especially if the children have to miss class time that is typically devoted to their core subjects[10]. In order to properly tailor future interventions, these barriers must be

addressed by devising the most cost-effective strategies to teach cooking and gardening behaviors in ways that require minimal resources, funding and time.

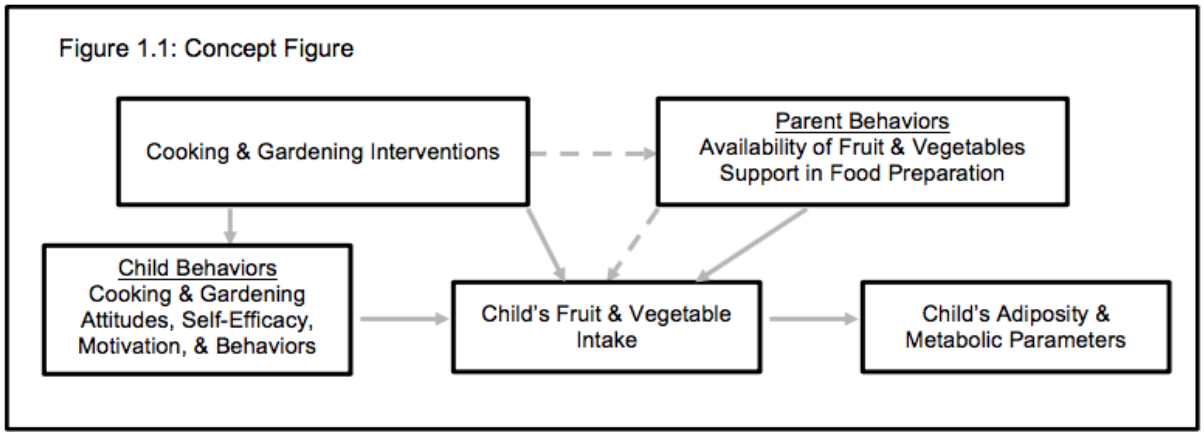
CONCLUSIONS

In conclusion, cooking and gardening appear to be effective means to improve children's dietary intake and preferences. It is important to determine how to realistically incorporate cooking and gardening into children's lives, especially high-risk and minority children, in order to improve the likelihood of their adoption of healthy habits from an early age. This requires analysis of the specific aspects of these programs and their effects to determine which component(s) is having the greatest impact in order to tailor future interventions to most effectively and cost-effectively increase children's cooking and gardening skills and self-efficacy to set them up with the tools they need to increase their fruit and vegetable intakes both in their childhood and as they transition into adults. More specifically, further analysis is required to determine whether cooking and gardening components and constructs are playing a role in the improvements in dietary intake and obesity parameters that are occurring as a result of these interventions. If they are, in fact, playing a significant role, they need not be watered down when these programs are scaled up.

The overall goal of this research is to determine how cooking and gardening behaviors and determinants of behaviors relate to dietary intake and obesity parameters in low-income, Hispanic youth. **Figure 1.1** depicts the concept diagram for this dissertation and highlights the relationship between the multiple factors that may be contributing to the improvements in dietary intake and obesity as a result of cooking and gardening interventions including both parent and child behaviors. **The specific aims of this**

research were: 1.) To examine the relationship between changes in cooking and gardening behaviors and determinants of behavior with the changes in dietary fiber intake, vegetable intake, BMI, and waist circumference that were observed as a result of the LA Sprouts intervention. 2.) To examine the relationship between child cooking involvement and parental support in food preparation with vegetable exposure, preference, and intake as well as BMI in the Texas Grow! Eat! Go! data set. And 3.) To assess the baseline relationship of cooking and gardening behaviors with fruit and vegetable intake in TX Sprouts randomized controlled intervention participants and controls.

Figure 1.1: Concept Figure



Chapter 2: Cooking and gardening behaviors and improvements in dietary intake in Hispanic/Latino youth

Markowitz AK, Landry MJ, Asigbee FM, Gatto NM, Spruijt-Metz D, Davis JN.

My specific contributions to this paper were designing the research question, conductng all data analysis, and serving as the primary author.

ABSTRACT

Background: School-based gardening interventions typically include both cooking and gardening (CG) components; however few studies have examined associations between CG behaviors, dietary intake, and obesity parameters. This study assessed whether changes in CG variables were associated with changes in dietary intake and obesity measures in children participating in an after-school, 12-week, randomized controlled nutrition, cooking and gardening intervention ("LA Sprouts").

Methods: A secondary analysis was conducted using data from 168 low-income, primarily Hispanic/Latino third through fifth grade students who completed the LA Sprouts intervention. The following measures were collected at baseline and post-intervention: height, weight, waist circumference (WC), dietary intake via the Block Screener, and CG variables via validated questionnaire. Partial correlations and Analysis of Covariance (ANCOVAs) assessed the relationship between changes in CG variables (specifically CG attitudes, self-efficacy, and motivation) with changes in dietary fiber (DF) intake, vegetable intake, Body Mass Index (BMI), and WC in the intervention group only.

Results: Increases in DF intake were positively related to increases in cooking attitudes (r=0.19; p=0.02), cooking self-efficacy (r=0.18; p=0.03), motivation to cook (r=0.17; p=0.04), gardening attitudes (r=0.22; p=0.01), motivation to garden (r=0.20; p=0.01), the

combination of cooking and gardening attitudes (r=0.22; p=0.01), and motivation to cook and garden (r=0.18; p=0.03). Students with the greatest improvement in cooking self-efficacy and the combination of CG attitudes had greater increases in DF intake (+1.6 vs. -1.0 g/day; p=0.04 and +1.7 vs. -1.1 g/day; p=0.03, respectively) compared to students with the smallest improvements. There were no significant associations between CG variables and vegetable intake, BMI, or WC.

Conclusions: Improvements in several cooking and gardening variables were linked to increased dietary fiber intake, which suggests that both the cooking and gardening components of the intervention are important to improve health in high-risk, minority youth.

INTRODUCTION

Childhood obesity continues to be a major problem in the United States (US) with 17.5% of children between the ages of 6 and 11 years (y) old characterized as obese in 2011-2014[1]. Hispanic/Latino youth are affected by obesity and obesity-related diseases at a disproportionately higher rate than non-Hispanic whites, with 25.0% percent of Hispanic children (6-11 y) being obese compared with 13.6% of non-Hispanic white children of the same age[1,7,9]. Children who are obese are more likely than their normal weight counterparts to exhibit cardiovascular disease (CVD) risk factors such as high blood pressure, increased triglycerides, type 2 diabetes (T2D), and non-alcoholic fatty liver disease [2,5–7]. Lower socioeconomic status (SES) is also associated with higher rates of obesity in youth in the US[11]. It is crucial to decrease obesity and metabolic disease risk, especially in this population.

Fruit and vegetable (FV) intake may be effective in the prevention of obesity and

adiposity[14,16,83]. FV consumption is associated with reduced risk of T2D, and vegetable consumption is linked to decreased visceral fat, liver fat, and insulin resistance in Hispanic/Latino youth[17,18]. Dietary fiber intake is inversely associated with WC, visceral adiposity, T2D risk factors, inflammation, and the metabolic syndrome[15,24–26] . Children in the US do not meet the recommended intake for FV or dietary fiber, and intake is lower in low-income and Hispanic/Latino populations often due to limited access to affordable and fresh FV[9,25,27,29–34]. Interventions that provide access to fresh FV and target increasing FV and dietary fiber intake in order to reduce risk of obesity and metabolic disease are warranted, especially in low-income, Hispanic populations.

Increased exposure to a food is associated with increased preference for that food, and food preferences are formed during childhood[37,84]. Thus, it is important to expose children to nutritious choices such as FV and other high-fiber foods early on. Children's preference for FV has been shown to predict FV consumption, so exposure to FV, specifically early in life, may lead to increased FV preference and consumption in childhood and into adulthood[40,85]. Psychosocial variables such as self-efficacy, attitudes, and knowledge of FV have been identified as key contributors in determining dietary behaviors in children[86].

School cooking and gardening programs are becoming a popular tool to teach children about nutrition and improve dietary intake, however the cooking and gardening components and strategies in these programs vary widely[9]. The majority of cooking and gardening programs use a hands-on approach and involve children in the planting and growing of FV, as well as the tasting and/or preparation of the produce. Evidence suggests that cooking and gardening programs that expose children to FV improve FV

preference and dietary intake, but it is important to determine which component(s) of these programs has a greater impact on these positive outcomes in order to tailor future studies appropriately[35,53,56–60,66,67,69,75].

The present study examines data from the 12-week cooking and gardening randomized controlled intervention, LA Sprouts, which demonstrated significant increases in dietary fiber and vegetable intake as well as significant decreases in BMI and WC in the intervention group compared with controls in low-income, primarily Hispanic/Latino third through fifth grade students[35]. The goal of the present study is to examine whether changes in cooking and gardening variables (attitudes, self-efficacy, and motivation) are correlated with the changes in dietary fiber and vegetable intakes, BMI, and/or WC changes that were observed in the LA Sprouts intervention group. The hypothesis is that improvements in cooking and gardening variables will be associated with greater improvements in adiposity measures and dietary intake observed in the intervention participants.

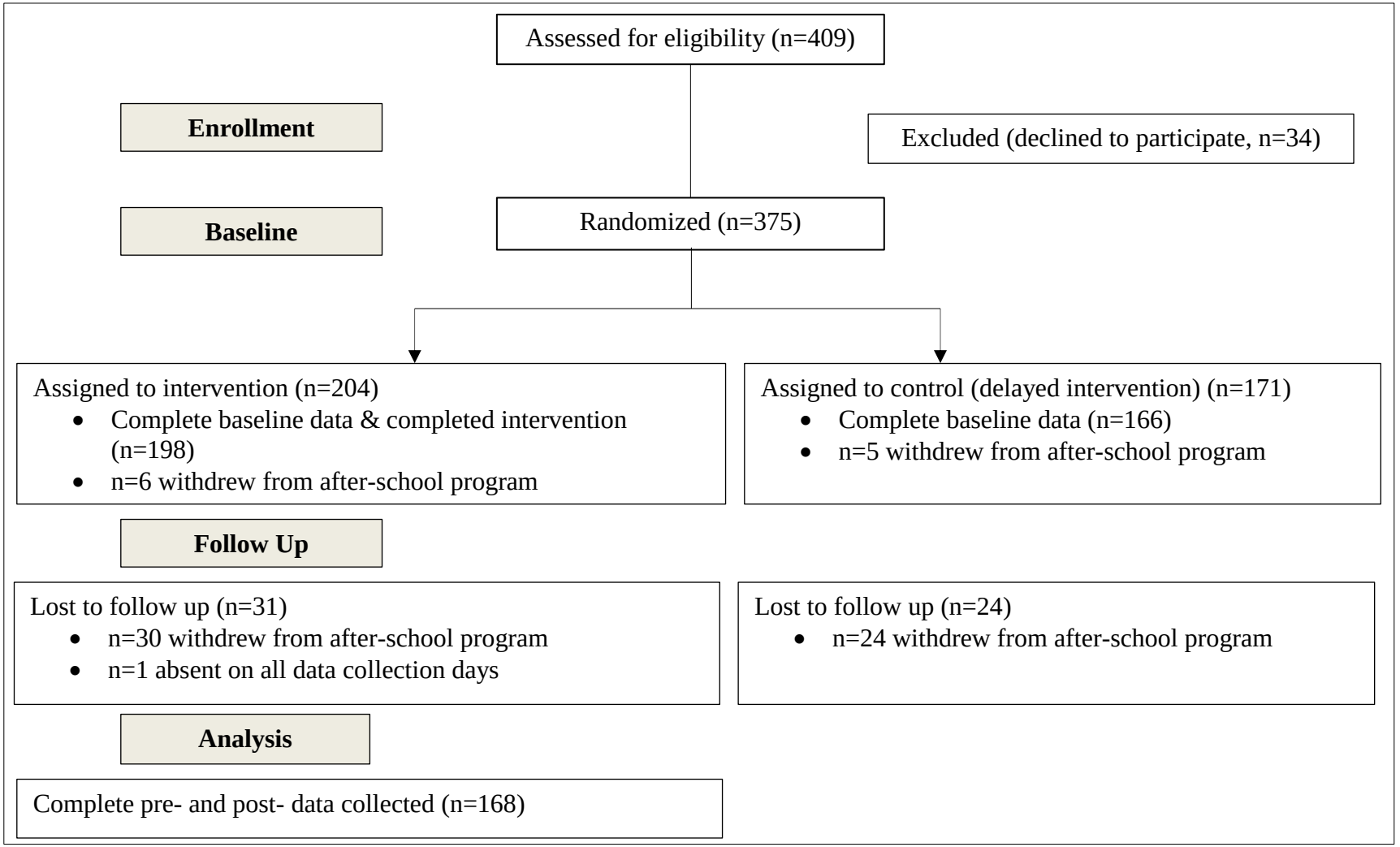
SUBJECTS AND METHODS

Subjects

The original LA Sprouts study involved 375 third through fifth grade students from four different schools in the Los Angeles Unified School District (LAUSD) who were all enrolled in the LA's Better Educated Students for Tomorrow (LA's BEST) afterschool program. The four schools were randomly assigned to either the intervention or control (delayed intervention). Schools were eligible for the study if they met the following criteria: (1) participation in LA's BEST, (2) at least 75% Hispanic/Latino, (3)

75% on the free and reduced lunch program, (4) located within 10 miles of the University of Southern California health sciences campus, (5) approval from LAUSD, and (6) expression of interest in being involved in the study. The main outcomes of the LA Sprouts intervention have been previously reported[35,87]. The present analysis uses the LA Sprouts intervention group only (n=168; **Figure 2.1**) to examine the relationship between cooking and gardening variables and the improvements in dietary intake and obesity parameters observed as a result of the intervention. The study was approved by the Institutional Review Boards of the University of Southern California, the University of Texas at Austin, Loma Linda University, and LA Unified School District.

Figure 2.1 Flow of Participants Through LA Sprouts



Note: Figure adapted from Gatto et al. *Pediatric Obesity. 2016.*

Description of the Intervention

The intervention took place afterschool on each school campus. Raised-bed gardens were built at each school, and classes were taught in designated teaching spaces near the gardens. The classes were 90 minutes in length and taught once a week to each grade during either the fall or spring semester. Each class consisted of 45 minutes of cooking and nutrition curriculum in addition to 45 minutes of gardening curriculum. Educators with nutrition and/or gardening experience were hired for this intervention to teach the lessons. Each week, students would work in small groups to prepare a recipe that featured fruit and/or vegetables as ingredients. Students would then eat that prepared dish together. Children also actively participated in gardening activities and were included in planting, growing, and harvesting FV. Participants learned about various aspects of healthy eating and gardening, such as the importance of dietary fiber, the benefits of eating FV, planning and planting a garden, and composting. More detailed information on the methodology, curriculum, and protocol is published elsewhere[9,88].

Measures

Obesity and anthropometric data were measured and questionnaires were collected pre- and post-intervention (within 7-14 days of instruction beginning or ending). The following anthropometric measures were collected: height via stadiometer (Seca, Birmingham, UK), weight and percent body fat via bioelectrical impedance (Tanita TBF 300A, Arlington Heights, IL), and WC via tape measure using NHANES protocol[89]. The Center for Disease Control cutoffs were used to calculate BMI z-scores and percentiles[6]. Dietary intake of dietary fiber, fruits, and vegetables were assessed

using the 41-item Block Kids Food Screener for Ages 2-17, 2007, which is designed to gather information on foods eaten "yesterday" and measures intake by food group[90]. Self-efficacy to cook and garden FV was assessed using a validated 14-item scale[91], and cooking and gardening attitudes were assessed using an 8-item scale developed by the researchers[88]. An adapted version of the Motivation for Health Behaving from the Treatment and Self-Regulation Questionnaire was used to assess motivation to cook and garden FV[92,93]. All child questionnaire scales were tested for internal consistency and intra-rater reliability using data from focus groups with nineteen Hispanic/Latino third through fifth grade students who were not part of LA Sprouts. Intra-rater reliability was tested using a test-retest method in which focus group participants completed the questionnaires at two time points with 7 days in between each test and was calculated with bivariate correlations that used averaged scale values of each participant. Internal consistency for each construct was calculated by Cronbach's alpha using baseline data from participants in the focus group. Both intra-rater reliability and internal consistency were satisfactory (alpha > 0.7). This data has been previously published[88] . **Table 2.1** provides the cooking and gardening questions from the questionnaire that were used in this analysis.

Statistics

Normality of all independent variables (cooking and gardening attitudes, self-efficacy, and motivation to cook and garden) was assessed using histograms and box plots, and all variables included in the analysis were distributed normally. Partial correlation coefficients were calculated to assess the relationship between changes in cooking and gardening attitudes, self-efficacy, and motivation (independent variables)

with changes in dietary fiber intake, vegetable intake, BMI z-scores, and WC (dependent variables) using the cooking and gardening variables presented in **Table 2.1**. The dietary fiber variable included grams of dietary fiber coming from fruit, vegetables, and whole grains. Change scores were calculated using post-intervention minus pre-intervention values of all variables (**Table 2.3**). If partial correlations were statistically significant ($p<0.05$), then changes in cooking and gardening variables were split into tertiles representing least change, mid-change, and most change. Analysis of Covariances (ANCOVAs) assessed if changes in dietary fiber and vegetable intakes, BMI, and WC differed by tertiles of changes in cooking and gardening variables, adjusted for covariates identified *a priori* including age, sex, ethnicity, changes in energy intake, baseline values for cooking and gardening variables, and baseline values for the dependent variable of interest. All data was analyzed using SPSS Statistics for Macintosh, Version 24.0 (IBM Corp, Armonk, NY) and an alpha level of $p=0.05$ was used for significance.

Table 2.1. LA Sprouts Cooking and Gardening Items on Questionnaire

Attitudes[a]	Self-Efficacy[b]	Motivation[c]
	"I think I can…"	"The reason I would cook/garden regularly is because…"
	Cooking	
Cooking is fun.	Help cook a dish with vegetables.	It is something we can do together as a family.
Cooking is easy.	Help cook a dish with fruits.	I believe it is a good thing for my health.
I like to cook.	Read a recipe.	My friends do this.
	Can use a sharp knife.	I have carefully thought about it and believe it is important for me.
		It is an important choice I want to make
		I want to set a good example for family and friends.
		I am concerned about my family's health.
	Gardening	
Growing FV[d] is fun.	Growing my own FV is easy	It is something we can do together as a family.
Growing FV is easy.	Grow FV at a community garden.	I believe it is a good thing for my health.
I like to garden.		I have carefully thought about it and believe it is important for me.
		It is an important choice I want to make.
		I want to set a good example for family and friends.
		I am concerned about my family's health.
		To make the world beautiful with plants and flowers.
		It is fun to grow things.

[a] Response categories: 1: I disagree very much; 2: I disagree a little; 3: I agree a little; 4: I agree very much
[b] Response categories: 1: I disagree very much; 2: I disagree a little; 3: I agree a little; 4: I agree very much
[c] Response categories: 1: Very untrue; 2: A little untrue; 3: A little true; 4: Very true
[d] FV: fruits & vegetables

RESULTS

Baseline demographic information, dietary intake, obesity measures, and cooking and gardening variables are presented in **Table 2.2**. Study participants were 48.0% male and 89.0% Hispanic/Latino with an average age of 9.3 years old. Fifty-one percent of the participants were either overweight or obese, and 88.1% were on the free or reduced lunch program. Average energy, vegetable, and dietary fiber intakes were 1481.0 ±106.7 kcal/day, 1.0 ±0.1 cup/day, and 13.0 ±0.8 g/day, respectively.

Table 2.2. LA Sprouts Baseline Characteristics

Characteristics	Intervention Group (n=168)
Demographics	
Male	80 (47.6)[a]
Hispanic	149 (89.0)
Age (years)	9.3 ±0.9
Free/Reduced Lunch Program	148 (88.1)
Anthropometrics	
Height (cm)	135.0 ±8.5
Weight (kg)	36.9 ±10.6
BMI (kg/m^2)	19.8 ±4.1
Waist Circumference (cm)	70.1 ±0.9
Overweight (≥85th percentile)	82 (51.3)
Obese (≥95th percentile)	54 (33.8)
Dietary intake	
Energy (kcal/day)	1480.96 ±106.7
Protein (g/day)	55.2 ±2.2
Fat (g/day)	54.1 ±2.1
Carbohydrates (g/day)	149.9 ±5.2
Dietary Fiber (g/day)	13.0 ±0.8
Vegetable (cups/d)	1.0 ±0.1
Cooking & Gardening Psychosocial Variables[b]	
Cooking Attitudes	10.0 ±0.2
Cooking Self-Efficacy	12.6 ±0.2
Motivation to Cook	22.0 ±0.4
Gardening Attitudes	10.2 ±0.2
Gardening Self-Efficacy	6.3 ±0.1
Motivation to Garden	28.0 ±0.5

[a]n (%) or mean ± standard deviation
[b]Scores determined from questionnaire; total possible scores: cooking attitudes: 12; cooking self-efficacy: 16; motivation to cook: 28; gardening attitudes: 12; gardening self-efficacy: 8; motivation to garden

Increases in dietary fiber intake were positively related to increases in cooking attitudes (r=0.19; p=0.02), cooking self-efficacy (r=0.18; p=0.03), motivation to cook (r=0.17; p=0.04), gardening attitudes (r=0.22; p=0.01), motivation to garden (r=0.20; p=0.01), the combination of cooking and gardening attitudes (r=0.22; p=0.01), and the combination of motivation to cook and garden (r=0.18; p=0.03) (**Table 2.3)** There were no significant associations between cooking and gardening behaviors and vegetable intake, BMI, or WC.

Table 2.4 shows the relationships between tertiles for changes in cooking and gardening variables with changes in dietary intake. Children with the greatest improvements in cooking self-efficacy and cooking and gardening attitudes consumed more dietary than those with the least improvements (-1.03 ±0.81g/day vs. 1.63 ±0.66g/day, p=0.04; -1.09 ±0.71g/day vs. 1.71 ±0.76g/day, p=0.03, respectively) (**Figure 2.2A & 2.2B**).

Table 2.3. Partial Correlations between Changes in Cooking and Gardening and Changes in BMI, Waist Circumference, Vegetable and Dietary Fiber Intake[a]

Cooking & Gardening Variables (change scores)	**BMI z-score** r (p-value)	**WC[b]** r (p-value)	**V[c]** r (p-value)	**DF[d]** r (p-value)
Cooking Attitudes	-0.02 (p=0.78)	-0.05 (p=0.57)	0.08 (p=0.31)	0.19 (p=0.02)*
Cooking Self-Efficacy "I think I can…"	0.01 (p=0.91)	0.02 (p=0.79)	0.04(p=0.62)	0.18 (p=0.03)*
Motivation to Cook	-0.01 (p=0.25)	0.00 (p=0.96)	0.09 (p=0.30)	0.17 (p=0.04)*
Gardening Attitudes	-0.03 (p=0.73)	0.05 (p=0.56)	0.06 (p=0.47)	0.22 (p=0.01)*
Gardening Self-Efficacy "I think I can…"	-0.02 (p=0.82)	-0.03 (p=0.73)	0.01 (p=0.89)	0.02 (p=0.79)
Motivation to Garden	-0.10 (p=0.25)	-0.07 (p=0.41)	0.13 (p=0.12)	0.20 (p=0.01)*
Cooking & Gardening Attitudes	-0.02 (p=0.77)	0.01 (p=0.88)	0.09 (p=0.27)	0.22 (p=0.01)*
Cooking & Gardening Self-Efficacy	-0.00 (p=0.96)	0.00 (p=1.0)	0.04 (p=0.66)	0.14 (p=0.09)
Motivation to Cook & Garden	-0.11 (p=0.19)	-0.05 (p=0.54)	0.11 (p=0.18)	0.18 (p=0.03)*

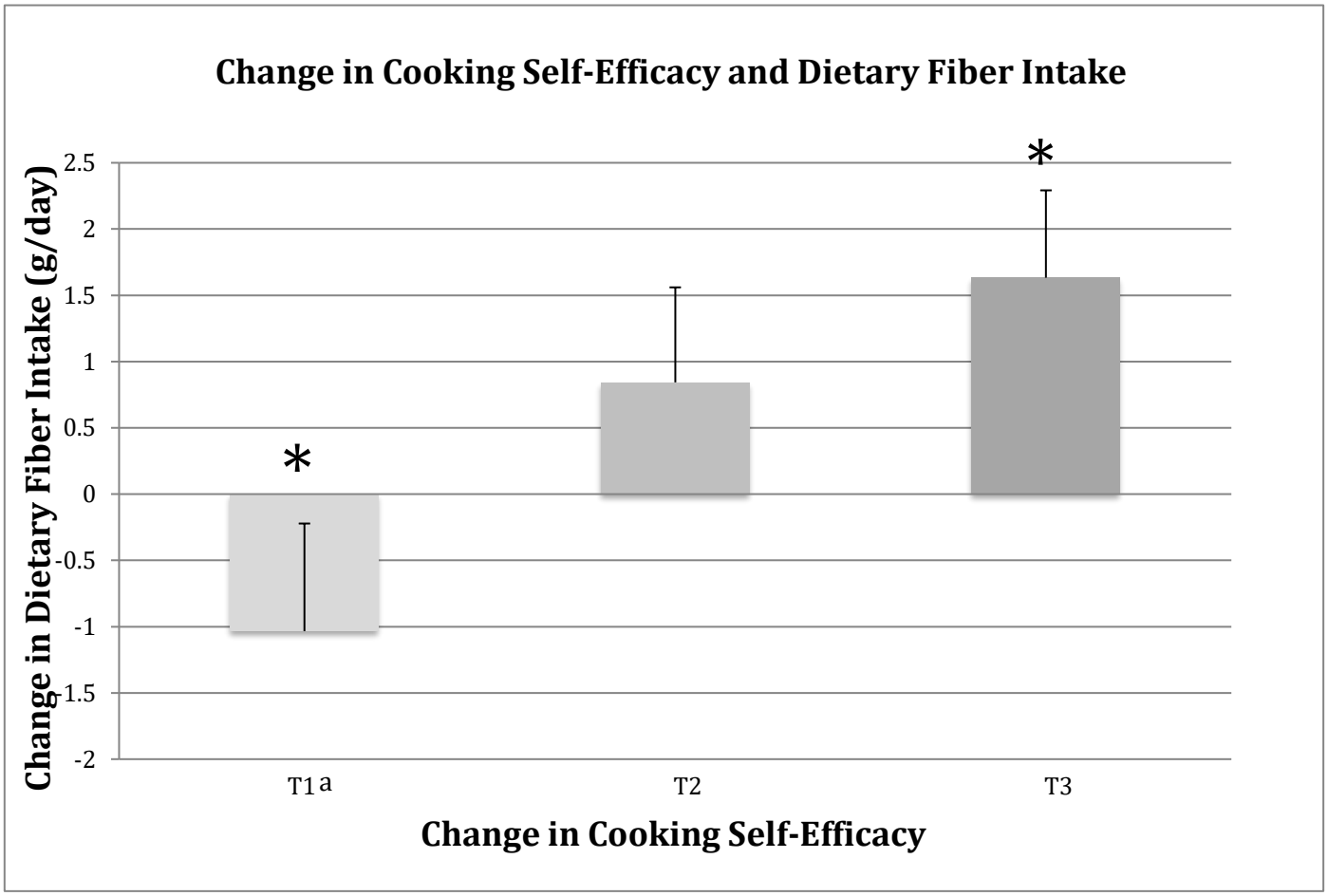
[a]Covariates in analysis: age, sex, ethnicity, change in dietary kilocalories, baseline value of CG variable, baseline BMI, WC, V, or DF intake
[b]WC: Waist circumference (centimeters)
[c]V: Vegetable intake (cups/day)
[d]DF: Dietary fiber intake (grams/day)
*Significant at $p<0.05$

Table 2.4. ANCOVA Results: Change in Cooking & Gardening Variables and Changes in Dietary Fiber Intake in Tertiles[a,b]

Cooking & Gardening Variables (change scores)	Tertile 1[c] **(Mean ±SE)**	Tertile 2 **(Mean ±SE)**	Tertile 3 **(Mean ±SE)**	p-value **(between T1 & T3)**
Cooking Attitudes	-0.872 ±1.032	0.02 ±0.647	1.890 ±0.693	0.09*
Cooking Self-Efficacy "I think I can…"	-1.034 ±0.812	0.843 ±0.717	1.633 ±0.659	0.04**
Motivation to Cook	-2.560 ±0.682	0.220 ±0.991	1.848 ±0.746	0.15
Gardening Attitudes	-0.924 ±0.760	1.803 ±0.822	1.16 ±0.796	0.23
Gardening Self-Efficacy "I think I can…"	0.133 ±0.603	-0.69 ±5.414	1.668 ±0.788	0.50
Motivation to Garden	0.075 ±0.709	-2.45 ±1.099	1.816 ±0.747	0.37
Cooking & Gardening Attitudes	-1.091 ±0.710	1.295 ±0.749	1.714 ±0.752	0.03**
Cooking & Gardening Self-Efficacy	0.050 ±0.594	-6.956 ±5.364	1.734 ±0.783	0.38
Motivation to Cook & Garden	-0.752 ±0.810	0.969 ±0.773	1.893 ±0.859	0.12

[a]Covariates in analysis: age, sex, ethnicity, change in dietary kilocalories, baseline value of CG variable, baseline DF intake
[b]Dietary fiber reported in grams per day (g/day)
[c]Tertile 1: least change; Tertile 2: mid-change; Tertile 3: most change
*Trending towards significance at $p<0.10$
**Significant at $p<0.05$

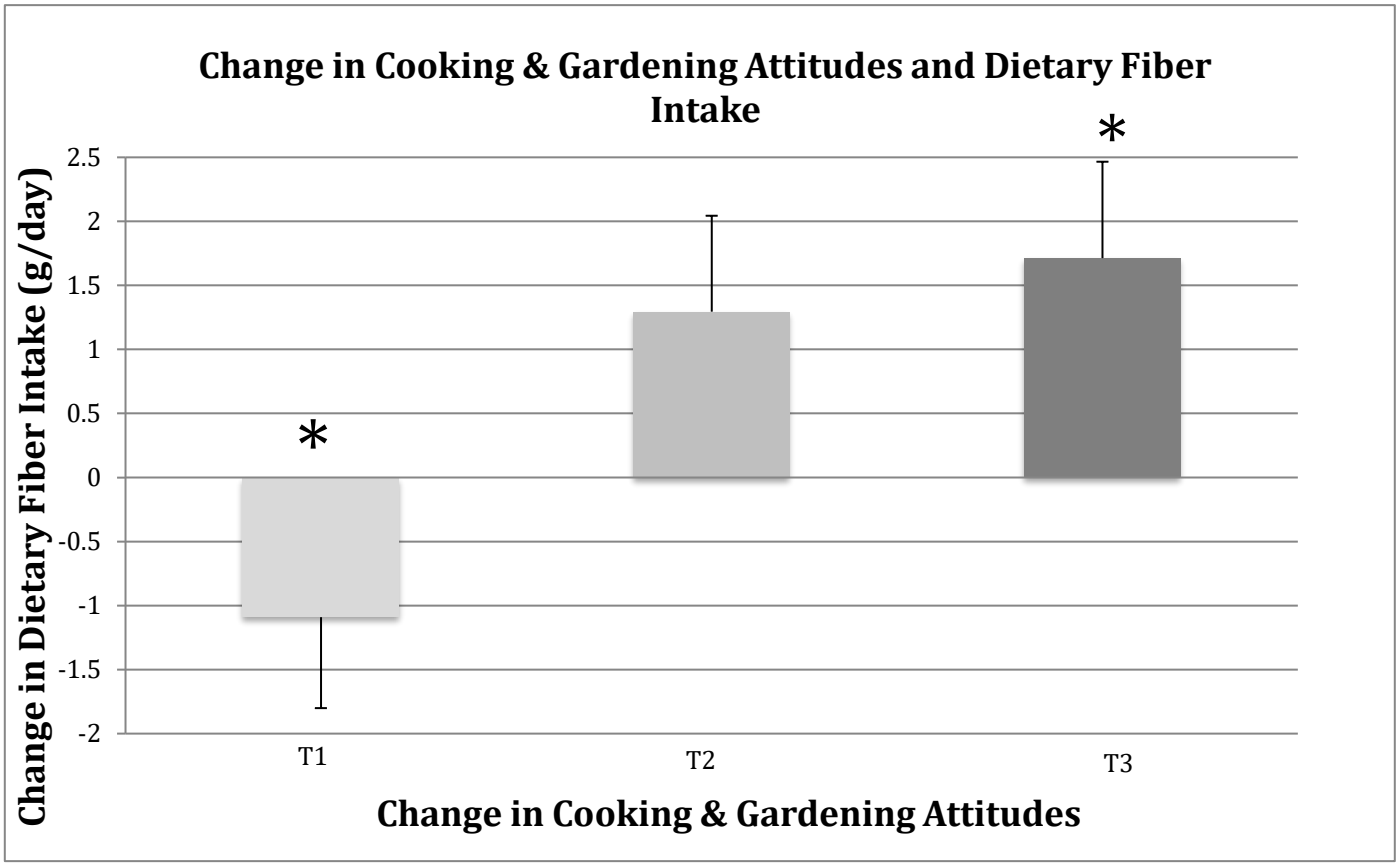
Figure 2.2A. ANCOVA Results: Association Between Tertiles of Changes in Cooking Self-Efficacy with Changes in Dietary Fiber intake.



*Significant at $p<0.05$

[a]T1: tertile 1, least change; T2: tertile 2, mid change; T3: tertile 3, most change

Figure 2.2B. ANCOVA Results: Association Between Tertiles of Changes in Cooking and Gardening Attitudes with Changes in Dietary Fiber Intake.



*Significant at $p<0.05$

[a]T1: tertile 1, least change; T2: tertile 2, mid change; T3: tertile 3, most change

DISCUSSION

This analysis sought to determine whether changes in cooking variables, gardening variables and/or in changes in the combination of both cooking and gardening variables were associated with the improvements in the dietary fiber and vegetable intake and reductions in adiposity measures observed in LA Sprouts intervention participants. The results showed that improvements in cooking attitudes, cooking self-efficacy, motivation to cook, gardening attitudes, motivation to garden, the combination of cooking and gardening attitudes, and the combination of motivation to cook and garden were all associated with increases in dietary fiber intake, indicating that both the cooking component and gardening component may be playing important roles in increasing dietary fiber intake.

Consistently, cooking and/or gardening interventions are effective at increasing FV preference and intake, and some even show reductions in obesity measures such as BMI and WC[53,56–60,66–69,75]. All of these interventions contain varying intensities of cooking and gardening, however the impact of changes in cooking and gardening variables on changes in dietary intake and health outcomes is unclear and not well studied. It is important to understand how cooking and gardening behaviors and attitudes influence dietary intake and health outcomes in order to tailor future interventions to focus on the component(s) that are eliciting the greatest positive outcomes.

The cooking component of cooking and gardening interventions can be costly and labor-intensive, so it is often the first to be eliminated from a program once it is scaled up from a pilot study or implemented by teachers in school[69]. Interventions may implement cooking demonstrations or taste tests rather than hands-on cooking instruction due to

these barriers[69]. The present study provides evidence that improvements in cooking variables, gardening variables, and the combination of cooking and gardening variables are demonstrating a beneficial effect on dietary fiber intake, and thus the cooking component may be worth the added time and expense in future cooking and gardening interventions.

Few other studies have looked at the effect of cooking and gardening interventions on cooking attitudes and self-efficacy in children, and this is the first to examine how cooking and gardening attitudes, self-efficacy, and motivation relate to changes in dietary intake and health outcomes in Hispanic/Latino youth. Although most of these garden-based interventions are multifaceted with varying degrees of cooking, gardening, and nutrition components, it has yet to be determined which of these is most closely associated with positive outcomes on intervention participants and whether or not it is actually the combination of components that is exerting the most beneficial outcomes[43,54–60,68,94,95].

Children enjoy learning actively by participating in gardening activities and by direct involvement in food preparation, which has been shown to result in greater improvements in cooking attitudes and behaviors[61,87,96]. It would make sense that the children who learn to prepare FV and dietary fiber-rich foods and have improved attitudes and beliefs regarding FV and dietary fiber-rich food preparation would be the ones who would adopt healthier eating habits compared to children who do not learn how to cook or participate in these hands-on learning activities. It is also possible that the "seed to mouth" nature of cooking and gardening interventions assists in the child identifying with foods that they had been foreign to them before. Perhaps after planting,

children adopt a personal connection with "their" produce, and may be more likely to consume it after having had that experience and connection with it. It is likely that the children who become invested in the process of planting, harvesting, and preparing healthful, dietary fiber-rich foods would be more inclined to consume these foods than children who had no such exposure to the cooking and gardening process. We found significant associations between improvements in both cooking and gardening behaviors and improvements in dietary fiber intake, suggesting that both aspects contributed to the improvements in intake of dietary fiber.

Limitations

The Block Kids Food Screener may not have been sensitive enough to capture other improvements in dietary intake such as decreases in sugar-sweetened beverage or processed food intakes or increases in vegetable intake, as it only asks about foods eaten "yesterday." There were no significant associations between any of the cooking and gardening variables and vegetable intake, which may have been due to the sensitivity of the screener. It could also be due to the fact that a dish prepared with vegetables alone is less palatable to children than a dish that includes other food groups including whole grains. A more sensitive screener may have captured a larger change in intake as a result of the intervention, and may have yielded stronger relationships between cooking and gardening variables and dietary intakes. This also would have allowed for analysis of additional associations between changes in cooking and gardening behaviors with a larger variety of changes in dietary intakes. Additionally, only four schools in the same city were involved in the study, limiting the generalizability of the findings. Lastly, the intervention did not result in significant changes in cooking and gardening variables in

the intervention group versus the control group, which is why the control group was not used in this analysis.

Conclusions

Our results indicate that both cooking and gardening variables are linked with increased dietary fiber intake in Hispanic/Latino youth, and future studies should incorporate both cooking and gardening aspects in interventions despite their potentially costly nature. Improving children's attitudes towards cooking and gardening and engaging them in these hands-on processes may promote improvements in their dietary intakes and the adoption of healthier habits that will hopefully accompany them into adulthood.

Chapter 3: Association Between Child Cooking Involvement and Parental Support in Food Preparation with Dietary Intake and Obesity in a Hispanic Youth Population

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My specific contributions to this paper were designing the research question, conductng all data analysis, and serving as the primary author.

ABSTRACT

Background: School-based cooking and gardening interventions have been linked to reductions in obesity and improvements in dietary intake in children. This study assessed whether child cooking involvement and parental support in food preparation were associated with Body Mass Index (BMI), fruit and vegetable (FV) intake, vegetable preference, and vegetable exposure in children participating in the school-based Texas, Grow! Eat! Go! (TGEG) randomized controlled trial (RCT).

Methods: Data included 1325 3rd grade students and 1206 of their parents who participated in the TGEG 9-month RCT, conducted in 28 low-income, primarily Hispanic schools across Texas. Schools were randomly assigned to one of the following groups: 1) a control group; 2) a school garden intervention [Learn, Grow, Eat & Go! (LGEG)]; 3) a physical activity intervention [Walk Across Texas (WAT)]; or 4) a combined gardening + physical activity intervention (LGEG plus WAT). Height, weight, dietary intake, child cooking involvement, and parental support in food preparation of child were collected at baseline and post-intervention. Partial correlations and Analysis of Covariance assessed the relationship between baseline child cooking involvement and parental support in food preparation with baseline BMI z-score, FV intake and vegetable preference. *A priori* covariates included: age, gender, ethnicity, and treatment group.

Results: Complete data were obtained from 1325 students (45% Hispanic, 49% overweight/obese). Children who cooked with their families had positive associations with vegetable preference ($r=0.24$; $p<0.01$), vegetable consumption ($r=0.26$; $p<0.01$), and fruit consumption ($r=0.24$; $p<0.01$). Students who cooked with their families most often compared with least often consumed double the amount of vegetables (+3.7 vs. +1.8 servings/day; $p<0.01$) and 63% more fruit (+1.9 vs. +1.2 servings/day; $p<0.01$, respectively). Parental support in food preparation was positively associated with vegetable preference ($r=0.13$; $p<0.01$) and vegetable exposure ($r=0.12$; $p=0.01$).
Conclusions: Interventions targeting child cooking involvement and parental support in food preparation may be an effective way to increase fruit and vegetable intake and preference, especially in high-risk, minority children.

INTRODUCTION

In 2011-2014, 17.5% of children in the United States (US) aged 6-11 years (y) were classified as obese[1]. A greater percentage of Hispanic children of this age group are affected by obesity than their non-Hispanic white counterparts (25.0% and 13.6%, respectively[1,7,9]). Low socioeconomic status (SES) is also linked to increased obesity prevalence in youth[11]. This is a serious concern, as childhood obesity is associated with a multitude of health problems both in childhood and later in life, such as cardiovascular disease (CVD), cancer, stroke, high blood pressure, increased blood triglycerides, type 2 diabetes (T2D), non-alcoholic fatty liver disease, inflammation, bone and joint problems, sleep apnea, asthma, and psychological problems[2,4–7].

Many studies have examined the effects of fruit and vegetable (FV) intake on weight gain, and results are mixed. Some studies show null results, while others

demonstrate that increased FV intake is associated with decreased weight gain and obesity[13,14,16,20,89,97]. FV intake is inversely associated with T2D risk, visceral fat, liver fat, and insulin resistance in Hispanic children[17,18]. Additionally, FV consumption may reduce the risk of many chronic diseases such as CVD, high blood pressure, stroke, rheumatoid arthritis, and asthma as well as various types of cancer[19,20]. FV intake is clearly beneficial to health and disease prevention and is an essential component of a healthy diet for children.

The majority of children in the US do not meet the dietary guidelines for FV, and Hispanic children and children from low SES households are at an even greater risk for not meeting these guidelines[12,19,29,98]. FV consumption is predicted by FV preference, and food preferences are formed during childhood[84]. It has been shown that repeated exposure to a particular food is correlated with developing a preference for that food[37]. Children typically do not like vegetables, so it is essential to expose them to vegetables as a means of increasing their preferences for vegetables early on[39]. Fruit and vegetable consumption is beneficial to overall health and needs to be integrated into the diets of US children, especially high-risk children, in order to decrease obesity and obesity-related diseases in this population. Finding novel ways to improve FV intake in these high-risk populations is warranted.

School-based cooking interventions show promise in effectively improving vegetable preference and consumption in children, but a few studies show no difference between intervention participants and controls[58,69,75,97]. However, the degree of cooking activities in these interventions differs widely. Food preparation skills have been identified as an important factor in improving dietary intake, and a lack of these skills is a

barrier to healthy food preparation and consumption[45]. One study found that cooking classes increase FV consumption in children, and numerous other studies have found that children who cook with their parents eat more FV than children whose parents cook without their child's involvement[49,76,99,100]. In addition to improvements in dietary intake, increased frequency of home meal preparation is associated with decreased per capita food expenses, making it a realistic method for improving dietary intake in low-income households[100].

Because parents play such a key role in determining what a child consumes, it is necessary to engage both children and parents in efforts to improve children's dietary intake[12]. Numerous parent behaviors have been identified as key contributors to improving child dietary intake such as providing access to vegetables at home and preparing meals together with their children[12,79,80,101]. It is necessary to get parents to provide support in food preparation activities and make healthy options available for their children in order to improve their dietary intake. School-based cooking and gardening interventions appear to successfully involve children and their parents, particularly those low-income and minority families, and may be a promising strategy to get children to prepare meals with their parents at home[79].

Teaching children to cook with their parents may be an effective and feasible strategy to improve FV intake in children, specifically in low-income populations, and needs to be explored further. The aim of this cross-sectional study is to examine the relationships between baseline child cooking involvement with FV preferences and intake in 1,325 low-income Hispanic third grade students in the Texas Grow! Eat! Go! randomized controlled trial participants. We hypothesize that greater child cooking

involvement and parental support in food preparation will be associated with greater preferences for and intake of fruits and vegetables.

SUBJECTS AND METHODS

Study Design

Baseline data from the TGEG intervention were used for this study. TGEG was a four-way group randomized controlled trial in which 28 schools from four counties in Texas were randomly assigned to one of the following groups: (1) Coordinated School Health only (control group), (2) Coordinated School Health plus gardening and nutrition intervention (Learn! Grow! Eat! Go! or LGEG group), (3) Coordinated School Health plus physical activity intervention (Walk Across Texas or WAT group), and (4) Coordinated School Health plus LGEG plus WAT (combined group). The research study was approved by the Texas A&M Institutional Review Board and the University of Texas Health Sciences Institutional Review Board.

School Eligibility Criteria

Schools were eligible for this study if they met the following criteria: (1) classified as a Title I school (at least 40% of the students live in low-income households) (2) located within four geographically distinct areas in Texas (Central Texas, Brazos Valley, Coastal South Texas, and South East Texas), (3) Coordinated Approach to Child Health (CATCH) implemented as chosen coordinated school health program[102] (4) district, principal, and third grade teacher commitment, and (5) willingness to allow data collection.

Subjects

The goal of the TGEG study was to recruit 50 student/parent dyads from each school to achieve a total sample size of 1600 dyads. Study packets were sent home with third grade students at the selected schools at the beginning of the school year in 2013 (cohort 1) and in 2014 (cohort 2). To be eligible for the study, students had to meet the following criteria: (1) enrollment in third grade at a selected school and (2) willingness to complete the student survey at four time points throughout the study. Students were not eligible if they were on a special diet or if their first language was not English or Spanish. Parents had to be able to read English or Spanish and be a parent or primary caretaker of a third grade student. Parents did not have to participate in order for their child to participate. Children gave assent at the first data collection session and also received a small incentive (i.e. ruler, measuring spoons, etc.) Parents did not receive incentives for participating in the study. The current analyses only uses baseline data, and more detailed information on the intervention groups is published elsewhere[79].

Measures

Child height was assessed using a stadiometer (PE-AIM-101) and child weight was determined using a digital Tanita scale (BWB 800S). BMI z-score was calculated using the 2000 CDC reference values[6]. Child cooking involvement, vegetable exposure, vegetable preference, vegetable consumption, and fruit consumption were assessed via the Child Survey, which was developed using previously validated questionnaires including the School Physical Activity and Nutrition (SPAN) Survey[103], the GIMME5 Survey[91], and the Marathon Kids Survey[104], with additional questions that address cooking created specifically for this study. Vegetable intake was

assessed using questions asking about foods consumed yesterday. Vegetable preference and vegetable exposure for 19 different vegetables were assessed using the questions “do you like to eat…” and “have you eaten…” respectively. Questions were tested during the pilot study, and then fine-tuned for the full study. Parental support in food preparation was assessed via the Parent Survey, which was developed based on previously validated questionnaires with additional questions created specifically for this study[38,91,105]. The Parent Survey was tested in a group of parents from the population and fine-tuned for the full study. **Table 3.1** includes the questions used to assess cooking behaviors.

Table 3.1. TGEG Cooking Questions

Parent Questionnaire	Answer Choices
Child Cooking Involvement *"In the past week did you do the following with your child?"*	Yes No
1. Prepared food together 2. Chose foods to buy at the grocery store together.	
Parental Support In Food Preparation *"In the past week did you do the following with your child?"*	
1. Planned meals that had vegetables that your child liked. 2. Took your child to the store to get vegetables. 3. Bought vegetables that your child liked. 4. Helped your child make a snack that includes vegetables. 5. Showed your child how to make vegetable snacks.	
Child Questionnaire	Never/Almost Never Sometimes Always/Almost Always
How often do you make food with members of your family?	

Statistics

All independent variables (child cooking involvement (CCI), parental support in food preparation (PS), and how often the child made food with his or her family (MF)) were assessed using histograms and box plots to confirm that these variables were normally distributed. Partial correlation coefficients were calculated to assess the relationship between baseline CCI, PS, and MF (independent variables) with baseline BMI z-score, vegetable exposure, vegetable preference, vegetable consumption, and fruit consumption (dependent variables). If partial correlations were statistically significant ($p<0.05$), then independent variables were split into tertiles representing lowest, middle, and highest CCI, PS, or MF, and Analyses of Covariance (ANCOVAs) were used to determine if baseline dependent variables (BMI z-score, vegetable exposure, vegetable preference, vegetable consumption, and fruit consumption) differed by baseline tertiles of independent variables (CCI, PS, and MF) adjusted for the following *a priori* covariates: age, gender, ethnicity, and treatment group. All data were analyzed using SPSS Statistics for Macintosh, Version 24.0 (IBM Corp, Armonk, NY) and an alpha level of $p=0.05$ was used for significance.

RESULTS

Demographic information, dietary intake BMI, child cooking involvement, parental support in food preparation, and frequency of child making food with his/her family at baseline are presented in **Table 3.2**. Complete data were obtained from 1325 students (43% Hispanic, 49% overweight/obese). **Table 3.3** displays partial correlations of child cooking involvement, parental support in food preparation, and frequency of

child making food with his/her family with vegetable exposure, vegetable preference, vegetable consumption, and fruit consumption. Frequency of the child making food with their families was positively associated with vegetable exposure ($r=0.12$; $p<0.01$), vegetable preference ($r=0.24$; $p<0.01$), vegetable consumption ($r=0.26$; $p<0.01$), and fruit consumption ($r=0.24$; $p<0.01$). Parental support in food preparation was positively associated with vegetable exposure ($r=0.12$; $p=0.01$) and vegetable preference ($r=0.13$; $p<0.01$). No other associations between child cooking involvement, parental support in food preparation, and frequency of child making food with his/her family were observed with any other independent variables.

Table 3.4 presents ANCOVA results of vegetable exposure, vegetable preference, vegetable consumption and fruit consumption by tertile of parental support in food preparation and frequency of child making food with his/her family. Students who made food with their families most often compared with least often ate 103% more vegetables (+3.7 vs. +1.8 servings/day; $p<0.01$) and ate 58% more fruit (+1.9 vs. +1.2 servings/day; $p<0.01$, respectively). Students whose parents provided the greatest support in food preparation compared with the least support liked 16% more vegetables (9.6 vs. 8.3 vegetables; $p<0.01$) and tasted 7% more vegetables when exposed to them (13.8 vs. 12.9 vegetables; $p=0.03$). No relationships between parental support in food preparation and vegetable or fruit consumption were observed.

Table 3.2. TGEG Child Baseline Characteristics[a]

Characteristics	N=1325 Total (%) or Mean ±SD[b]
Demographics	
Male	652 (49.2)
Hispanic	567 (42.7)
Age (years)	8.3 ±0.6
Free/Reduced Lunch	883 (77.8)
Anthropometrics	
Height (cm)	132.6 ±6.5
Weight (kg)	34.1 ±9.7
BMI (kg/m^2)	19.2 ±4.2
Overweight ($\geq 85^{th}$ percentile)	598 (48.5)
Obese ($\geq 95^{th}$ percentile)	367 (29.8)
Dietary Intake & Preference	
Vegetables (cups/day)	2.6 ±2.5
Fruit (cups/day)	1.6 ±1.2
Vegetable Preference[c]	8.9 ±4.1
Vegetable Exposure[d]	12.2 ±4.0
Cooking Variables	
Child Cooking Involvement[e]	1.3 ±0.8
Parental Support in Food Preparation[f]	3.0 ±1.6
Frequency Child Made Food with Family[g]	1.2 ±0.7

[a]Table modified from Evans et al. (BMC Public Health 2016)
[b]SD: standard deviation
[c]Vegetable preference: "Do you like to eat…" (list of 19 vegetables); Answer choices: 0=no, 1=yes
[d]Vegetable exposure: "Have you eaten…" (list of 19 vegetaebles); Answer choices: 0=no, 1=yes
[e]In the past week, did you do the following with your child? (1) Prepared food together, (2) Chose foods to buy at the grocery store together; Answer choices: 0=no, 1=yes
[f]In the past week, did you do the following with your child? (1) Planned meals that had vegetables your child liked, (2) Took your child to the store to get vegetables, (3) Bought vegetables that your child liked, (4) Helped your child make a snack that includes vegetables, (5) Showed your child how to make vegetable snacks; Answer choices: 0=no, 1=yes
[g]How often do you make food with members of your family?; Answer choices: 0=never or almost never, 1=sometimes, 2=always or almost always

Table 3.3. Partial Correlations of Cooking Variables with Vegetable Exposure and Preference and Fruit and Vegetable Intake

Dependent Variables[a]	Independent Variables		
	Child Cooking Involvement *r (p-value)*	**Parental Support in Food Preparation** *r (p-value)*	**Frequency of Child Making Food with Family** *r (p-value)*
BMI z-score	-0.07 (p=0.13)	-0.07 (p=0.16)	0.03 (p=0.50)
Vegetable Preference[b]	0.01 (p=0.86)	0.13 (p<0.01)*	0.24 (p<0.01)*
Vegetable Exposure[c]	0.04 (p=0.43)	0.12 (p<0.01)*	0.12 (p<0.01)*
Vegetable Consumption[d]	0.02 (p=0.71)	0.08 (p=0.08)	0.26 (p<0.01)*
Fruit Consumption	0.01 (p=0.90)	0.04 (p=0.42)	0.24 (p<0.01)*

[a]Covariates in analysis: age, gender, ethnicity, and treatment group
[b]Vegetable preference: "Do you like to eat…" (list of 19 vegetables); Answer choices: 0=no, 1=yes
[c]Vegetable exposure: "Have you eaten…" (list of 19 vegetables); Answer choices: 0=no, 1=yes
[d]Cups per day
*Significant at p<0.05

Table 3.4. ANCOVA Results of Cooking Variables with Vegetable (V) Exposure and Preference and Fruit and Vegetable Intake in Tertiles[a]

Cooking Variables	*Child Making Food with Family*[b]				*Parental Support in Food Preparation*[c]			
	Tertile 1[h,i]	**Tertile 2**	**Tertile 3**	**p-value[j]**	**Tertile 1**	**Tertile 2**	**Tertile 3**	**p-value**
V Preference[d]	7.54 ±0.38	9.00 ±0.25	10.11 ±0.26	p<0.01*	8.23 ±0.28	9.31 ±0.30	9.61 ±0.27	p<0.01*
V Exposure[e]	12.73 ±0.34	13.38 ±0.22	13.89 ±0.24	p<0.01*	12.91 ±0.26	13.30 ±0.27	13.82 ±0.25	p=0.03*
V Consumption[f]	1.82 ±0.26	2.46 ±0.17	3.68 ±0.18	p<0.01*	2.44 ±0.20	2.81 ±0.21	3.06 ±0.19	p=0.06
Fruit Consumption[g]	1.18 ±0.11	1.47 ±0.08	1.92 ±0.08	p<0.01*	1.53 ±0.86	1.50 ±0.09	1.71 ±0.08	p=0.40

[a]Covariates in analysis: age, gender, ethnicity, and treatment group
[b]How often do you make food with members of your family?; Answer choices: 0=never or almost never, 1=sometimes, 2=always or almost always
[c]Sum of the following questions: In the past week, did you do the following with your child? (1) Planned meals that had vegetables your child liked, (2) Took your child to the store to get vegetables, (3) Bought vegetables that your child liked, (4) Helped your child make a snack that includes vegetables, (5) Showed your child how to make vegetable snacks; Answer choices: 0=no, 1=yes
[d]Vegetable preference: "Do you like to eat…" (list of 19 vegetables); Answer choices: 0=no, 1=yes
[e]Vegetable exposure: "Have you eaten…" (list of 19 vegetables); Answer choices: 0=no, 1=yes
[f,g]Cups per day
[h]Tertile 1: lowest MF; Tertile 2: middle MF; Tertile 3: highest MF
[i]Tertiles expressed in Mean ±standard error
[j]Between Tertile 1 and 3
*Significant at p<0.05

DISCUSSION

Our results showed that children who prepared food with their families consumed more fruits and vegetables, demonstrating that this may be an effective strategy to improve dietary intake in this high-risk population. We also found that children whose parents provided more support in food preparation were willing to try more vegetables and had a greater preference for more vegetables than children whose parents provided the least support. Because exposure to a food is linked to preference for that food, improving a child's willingness to taste a vegetable as well as improving their preferences for that vegetable are crucial steps in getting children to consume more vegetables[37,84].

Parents play a critical role in determining what their child eats, and certain parental behaviors have been linked to improvements in children's dietary intake such as making healthful options like fruits and vegetables available at home as well as preparing meals together with their children[79]. Thus, it is necessary to involve both parents and children in order to improve the child's dietary intake.

School-based cooking interventions are an effective way to reach parents and get them to make meals with their children at home[79]. Many school cooking interventions appear to improve FV intake in children, but a few have shown no difference between the intervention group and the control group[97]. One study examined the effect of children helping their parents prepare a meal for lunch on subsequent intake at that meal. The study included 47 children between the ages of 6 and 10 years old in Switzerland who were randomly assigned to either the "child cooks" condition or the "parent cooks" condition. The child helped the parent cook in the "child cooks" condition and the parent

cooked alone in the "parent cooks" condition. Results showed that children in the child cooks condition ate 41.7g (76.1%) more salad than children in the parent cooks condition[49]. Similarly, a study conducted with 3,398 fifth grade children found that children who were more involved in preparing meals at home with their parent ate an additional serving of fruits and vegetables compared with children who were not involved[48]. These results are consistent with the findings of the present study, demonstrating that children cooking with their parents at home may be an effective way to encourage children to eat more fruits and vegetables.

Cooking interventions are gaining popularity as a means to get children in the kitchen and subsequently improve their dietary intake, but the components and strategies used in these interventions vary widely. Sometimes the children are taught food preparation skills in a hands-on fashion and sometimes children watch cooking demonstrations. Because cooking with children can be laborious as well as quite costly, the cooking component tends to be watered down when interventions are scaled up[69]. Our findings suggest that hands-on cooking and involvement in food preparation are associated with better dietary intake, indicating that cooking should be a primary focus of future interventions that target improving dietary intake in children despite the potential cost and labor intensiveness.

This study has a few limitations that need to be addressed. The dietary behaviors of participants were assessed using a questionnaire that only asked about foods eaten "yesterday." The potential problem exists that the previous day's intake is not reflective of a child's overall dietary intake. Also, the young age of the students poses the potential issue of lack of reading comprehension and full understanding of the questions being

asked. However, survey questions were field tested in the target population. Lastly, it would have been worthwhile to assess changes in child cooking involvement and parental support in food preparation between baseline and post-intervention. Unfortunately, this could not be assessed, as too many parents did not participate in the post-intervention measurements.

Because, in general, children do not eat enough fruits and vegetables, which are essential to health and prevention of disease, it is important to determine the most effective ways to increase consumption. It is especially critical to improve fruit and vegetable intake in high risk, low-income populations, as these children are at a disproportionately higher risk for developing obesity and obesity-related diseases. This study shows that high-risk, minority children being more involved in food preparation at home may yield an improved intake of fruits and vegetables as well as an increased willingness to try and preference for vegetables. Because home meal preparation is inversely associated with per capita food expenses, cooking at home is a feasible strategy to improve dietary intake without increasing expenses for low-income, Hispanic families[100]. Further interventions that target parents and children cooking together at home, especially in Hispanic and/or low-income populations are warranted.

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Healthy Living, The University of Texas School of Public Health, Austin Regional Campus.

Chapter 4: Association Between Child Cooking and Gardening Involvement, Attitudes, and Self-efficacy with Dietary Intake in a Hispanic Youth Population

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My specific contributions to this paper were designing the research question, conductng all data analysis, and serving as the primary author.

ABSTRACT

Background: School-based cooking and gardening interventions show promise in improving children's fruit and vegetable (FV) intake, but few studies examine the direct relationship between cooking and gardening behaviors and determinants of behavior with subsequent FV intake. This study assessed the baseline relationship between cooking and gardening involvement, attitudes, and self-efficacy with FV intake in low-income, Hispanic children.

Design: A cross-sectional analysis was conducted using baseline data for 1,832 low-income, primarily Hispanic 3rd through 5th grade students who participated in TX Sprouts, a randomized controlled school-based cooking and gardening intervention. The following measures were assessed at baseline: height, weight, body mass index (BMI), dietary intake via 14-item screener, and cooking and gardening involvement, attitudes, and self-efficacy via questionnaire. Partial correlations and Analysis of Covariance (ANCOVAs) were used to determine the association between cooking and gardening variables with FV intake.

Results: Cooking and gardening involvement, attitudes, and self-efficacy were all positively correlated with fruit intake ($r=0.08$ - $r=0.11$; all $p<0.01$) and vegetable intake ($r=0.12$ - $r=0.25$; all $p<0.01$). Students most involved with cooking consumed 17% more

fruit and 52% more vegetables compared with students who were least involved ($p<0.01$), and students most involved in gardening ate 27% more fruit and 80% more vegetables than those who were least involved ($p<0.01$). Students with the most positive cooking attitudes, gardening attitudes, cooking self-efficacy, and gardening self-efficacy had significantly higher intake of fruit (12%, 22%, 20%, and 17%, respectively) and vegetables (28%, 56%, 32%, and 38%, respectively), compared with students with the least positive cooking and gardening attitudes (all p values <0.05).

Conclusions: Cooking and gardening involvement, attitudes, and self-efficacy are positively associated with FV intake, suggesting that improving cooking and gardening behaviors are effective strategies to use to improve FV intake in high-risk, low-income and minority youth populations.

BACKGROUND

Childhood obesity is a major concern in the United States (US), as it affects 17.5% of children between the ages of 6 and 11 years[1]. Twenty-five percent of Hispanic youth are affected by obesity compared with 13.6% of affected non-Hispanic white youth of the same age[1]. Low socioeconomic status (SES) is also associated with obesity in youth[11]. Childhood obesity is linked with many serious health issues later in life, such as cardiovascular disease (CVD), cancer, stroke, type 2 diabetes (T2D), non-alcoholic fatty liver disease, and inflammation[2,7,9]. It is crucial to reduce childhood obesity, especially in high-risk, low-income and Hispanic children.

Fruits and vegetables are an essential part of a healthy diet and may prevent weight gain and reduce the risk of obesity[14,16,83]. Fruits, vegetables, and dietary fiber-rich foods are also associated with decreased risk of T2D, visceral fat, liver fat, and insulin

resistance in Hispanic children[15,17,18]. Children in the US do not meet the dietary guidelines for fruit and vegetable consumption, and intake is even lower in Hispanic and low-income children, as they may have restricted access to fruits and vegetables[9,27,31,98]. Providing children, especially high-risk children, access to fresh fruits and vegetables as well as teaching them to incorporate more fruits and vegetables into their diets is needed to help them maintain health and prevent obesity and obesity-related diseases.

Cooking at home is linked with increased fruit and vegetable consumption, while eating outside of the home is linked with decreased fruit and vegetable consumption[10,44]. When children are involved with cooking at home, they eat more fruits and vegetables than children who are not involved. For example, in a cross-sectional analysis of fifth grade students (n=3,398), it was shown that children who participated in daily meal preparation at home ate one additional serving of fruits and vegetables per day compared with children who did not participate[48].

Gardening is also associated with improvements in dietary intake. One study involving 1,121 college students found that students who currently garden or who had gardened in childhood ate significantly more fruits and vegetables than those who had never gardened. Additionally, fruit and vegetable intake was positively correlated with frequency of gardening[22].

Cooking and gardening interventions are emerging as a useful tool to expose children to fruits and vegetables and many have shown to improve children's preferences for and consumption of fruits and vegetables[19,35,53,67,106]. For example, an after-school 12-week randomized cooking, gardening, and nutrition intervention delivered to 319 low-income, primarily Hispanic third through fifth grade students in the Los Angeles area

found significant increases in vegetable and dietary fiber consumption as a result of the intervention[35]. Similarly, a 12-week cooking and gardening intervention involving two weekly gardening and nutrition education sessions coupled with fruit and vegetable taste tests and snack preparation was conducted in 93 fourth through sixth grade students and demonstrated significant increases in fruit and vegetable preferences and intake[61].

Interventions that contain only a cooking component appear to also yield positive results. One study that included hands-on cooking classes and fruit and vegetable tastings was delivered to 257 fourth grade students and resulted in improvements in vegetable preference[69]. Similarly, another study that included hands-on cooking classes with local chefs resulted in increased vegetable intake in fourth and fifth grade students[75].

These programs contain varying degrees of cooking and gardening components, so it is important to determine which aspects of the individual components are having a larger impact on fruit and vegetable intake by examining specific cooking and gardening behaviors and determinants of behavior and their relationship to improvements in dietary intake, especially in high-risk populations. Hands-on cooking and gardening with children can be quite costly and labor-intensive, so it is pertinent to tease out whether both of these aspects are necessary in order to properly tailor future interventions for maximum effectiveness with minimal cost and labor.

The goal of the present study is to examine whether involvement in cooking and/or gardening behaviors and improvements in determinants of behavior (attitudes and self-efficacy) are correlated with fruit and vegetable intake in Hispanic children from low-income elementary schools. The hypothesis is that greater involvement in cooking

and gardening as well as more positive cooking and gardening attitudes and self-efficacy will be associated with increased fruit and vegetable intake.

SUBJECTS AND METHODS

TX Sprouts Intervention

TX Sprouts is a one-year cooking, gardening, and nutrition education intervention that is being conducted in a total of 16 elementary schools in the Austin area in approximately 2,800 third through fifth grade students. The intervention will take place over the course of three school years (2016-2019), with the first two waves each including three intervention schools and three control schools and the final year including two intervention schools and two control schools. The present analysis uses baseline data from all participants in the first and second waves with complete data for all demographics, anthropometrics, dietary intake, and cooking and gardening information presented in **Table 4.1** (n=1,832).

Table 4.1. TX Sprouts Child Baseline Characteristics

Characteristics (N=1,832)	Total n(%) or Mean ±SD[a]
Demographics	
Male	854 (46.6)
Hispanic	1165 (63.6)
Age (years)	9.2 ±0.9
Free/Reduced Lunch	1233 (67.4)
Anthropometrics	
Height (cm)	138.3 (30.2)
Weight (kg)	40.6 (42.9)
BMI (kg/m^2)	20.2 (6.2)
Overweight/Obese	1141 (46.3)
Dietary intake	
Vegetables (times/day)[b]	5.0 ±5.9
Fruit (times/day)[c]	1.3 ±1.2
Cooking & Gardening Variables	
Cooking Involvement[d]	1.3 ±1.0
Gardening Involvement[e]	1.3 ±1.2
Cooking Attitudes[f]	4.2 ±1.7
Cooking Self-Efficacy[g]	10.8 ±3.7
Gardening Attitudes[h]	6.1 ±2.6
Gardening Self-Efficacy[i]	2.1 ±1.1

[a]SD: standard deviation
[b]Measured in times per day; Max number of times = 3; Total possible score = 24
[c]Measured in times per day; Total possible score = 3
[d]Total possible score = 2
[e]Total possible score = 3
[f]Total possible score = 6
[g]Total possible score = 15
[h]Total possible score = 9
[i]Total possible score = 3

School Eligibility

Schools within 60 miles of the University of Texas at Austin campus were eligible for the TX Sprouts randomized controlled intervention if: 1) >50% of the students were Hispanic 2) >50% of the students were enrolled in the National School Lunch Program and received free or reduced-cost lunch, 3) the school expressed interest in a school gardening program, and 4) the school did not have an existing school garden or gardening program.

Measures

Height was assessed using a stadiometer to the nearest 0.1cm, weight was assessed using a Tanita Body Fat Analyzer (model TBF 300) to the nearest 0.1kg. BMI (kg/m^2), and BMI percentiles were calculated using CDC age and gender-specific values (EpiInfo 2005). Waist circumference to the nearest 0.1cm was assessed using a tape measure[89]. Bioelectrical impedance with the Tanita Body Fat Analyzer (model TBF 300) was used to determine body fat composition. Dietary intake was assessed using an adapted version of the School Physical Activity and Nutrition (SPAN) Survey containing 14 items asking about the number of times fruit and vegetables were consumed the previous day (see **Table 4.2** for specific questions and responses)[103]. Demographics and cooking and gardening information were collected via a questionnaire that was adapted from the questionnaire used in the LA Sprouts randomized controlled cooking, gardening, and nutrition intervention[88]. The following cooking and gardening constructs were assessed: cooking and gardening involvement, attitudes, and self-efficacy (see

Table 4.3 for specific questions and responses). Surveys were available in English and Spanish and bilingual interpreters were available to assist with comprehension.

Table 4.2. Fruit and Vegetable Intake Questions

Fruit Intake	Answer Choices
1. Yesterday, did you eat any fruit, either fresh or frozen?	No, I did not eat any of these. Yes, I ate at least 1 of these 1 time. Yes, I ate at least 1 of these 2 times. Yes, I ate at least 1 of these 3 or more times.
Vegetable Intake *Yesterday, did you eat any of these vegetables:*	
1. Carrots, beets, sweet potatoes, or radishes? 2. Squash, green beans, or cucumbers? 3. Tomatoes or peppers? 4. Broccoli, cauliflower, or cabbage? 5. Leafy green vegetables? 6. Potatoes, corn, or peas? 7. Pinto, garbanzo, kidney, or black beans? 8. Herbs like cilantro, basil, or mint?	

Table 4.3. TX Sprouts Cooking & Gardening Questions

Cooking Involvement *How often do you…*	**Answer Choices**
1. Help make or cook food with your family? 2. Shop together for food?	Never/Almost Never Sometimes Always/Almost Always
Gardening Involvement *In the past year have you…*	
1. Planted seeds or plants in a vegetable garden? 2. Picked fruit or vegetables from a vegetable garden? 3. Tasted fruit or vegetables from a vegetable garden? 4. Pulled weeds or watered plants from a vegetable garden?	
Cooking Attitudes	I disagree very much. I disagree a little. I agree a little. I agree very much.
1. Cooking is fun. 2. Cooking is easy.	
Cooking Self-Efficacy *I think I can…*	
1. Help make or cook a dish with vegetables. 2. Help make or cook a dish with fruit. 3. Help shop for fruits and vegetables at the store. 4. Make a dish from a recipe. 5. Use a knife to chop fruits and vegetables.	
Gardening Attitudes	
1. Growing my own fruits and vegetables is fun. 2. Growing my own fruits and vegetables is easy. 3. Vegetables from the garden taste better than from the store.	
Gardening Self-Efficacy *I think I can…*	
1. Grow fruits or vegetables at my home.	

Statistics

Partial correlations were used to evaluate the relationship between baseline cooking and gardening variables (cooking involvement, gardening, cooking attitudes, cooking self-efficacy, gardening attitudes, and gardening self-efficacy) with fruit and vegetable intake. Age, sex, ethnicity/race, school, and BMI percentile were used as *a priori* covariates.

If partial correlations were significant ($p<0.05$), cooking and gardening variables were split into tertiles encompassing the lowest, middle, and highest groups. Analysis of Covariance (ANCOVAs) were run to assess whether fruit and/or vegetable consumption differed by tertile of cooking and/or gardening involvement, attitudes, and self-efficacy. SPSS Statistics for Macintosh, Version 24.0 (IBM Corp, Armonk, NY), and an alpha level of $p=0.05$ were used for all analyses.

RESULTS

Baseline characteristics including demographics, anthropometrics, dietary intake, and cooking and gardening variable information are presented in **Table 4.1**. Complete anthropometrics, demographics, dietary intake, and cooking and gardening data pertaining to this analysis were obtained from 1,832 students (64% Hispanic, 47% male, 46% overweight/obese, 67% received free or reduced-cost lunch through the National School Lunch Program).

Partial correlation results of all independent variables (cooking involvement, gardening, cooking attitudes, cooking self-efficacy, gardening attitudes, and gardening self-efficacy) with dependent variables (fruit intake and vegetable intake) are displayed in

Table 4.4. Cooking involvement, gardening, cooking attitudes, cooking self-efficacy, gardening attitudes, and gardening self-efficacy were all positively correlated with fruit and vegetable intake (all p values <0.01).

ANCOVA results of fruit and vegetable intake by tertile of all independent variables are presented in **Table 4.5**. Students most involved in cooking compared with least involved consumed 52% more vegetables and 17% more fruit (+6.4 vs. +4.2 times/day; p<0.01 and +1.4 vs. +1.2 times/day; p<0.01, respectively). Students who gardened most often compared with least often ate 80% more vegetables and 27% more fruit (+6.3 vs. +3.5 times/day; p<0.01 and +1.4 vs. +1.1 times/day; p<0.01, respectively). Students with the most positive cooking attitudes, gardening attitudes, cooking self-efficacy, and gardening self-efficacy compared with the least positive ate significantly more fruit (12%, 22%, 20%, and 17%, respectively) and vegetables (28%, 56%, 32%, and 38%, respectively) (all p-values <0.05).

Table 4.4. Partial Correlations: Relationship Between Cooking & Gardening Behaviors and Fruit and Vegetable Intake

	Dependent Variables			
Independent Variables[a]	**Fruit Intake**		**Vegetable Intake**	
	r	p-value	r	p-value
Cooking Involvement[b]	0.098	<0.001*	0.150	<0.001*
Gardening Involvement[c]	0.112	<0.001*	0.251	<0.001*
Cooking Attitudes[d]	0.071	<0.001*	0.071	0.001*
Cooking Self-Efficacy[e]	0.106	<0.001*	0.117	0.001*
Gardening Attitudes[f]	0.085	<0.001*	0.183	0.001*
Gardening Self-Efficacy[g]	0.075	<0.001*	0.120	0.001*

[a]Covariates in analysis: age, gender, ethnicity, school, BMI percentile
[b]Total score possible = 4
[c]Total score possible = 3
[d]Total score possible = 6
[e]Total score possible = 15
[f]Total score possible = 9
[g]Total score possible = 3
*Significant at $p<0.05$

Table 4.5. ANCOVA Results: Cooking & Gardening Variables and Fruit and Vegetable Intake in Tertiles[a]

Cooking Variables	Fruit Intake[h]				Vegetable Intake[i]			
	Tertile 1[j,k]	Tertile 2	Tertile 3	p-value (T1 vs T3)	Tertile 1	Tertile 2	Tertile 3	p-value (T1 vs T3)
Cooking Involvement[b]	1.18 ±0.04	1.32 ±0.04	1.41 ±0.05	p<0.01	4.16 ±0.18	10.50 ±0.02	6.40 ±0.22	p<0.01*
Gardening Involvement[c]	1.14 ±0.04	1.40 ±0.05	1.40 ±0.04	p<0.01	3.51 ±0.19	5.23 ±0.22	6.30 ±0.19	p<0.01*
Cooking Attitudes[d]	1.22 ±0.04	1.30 ±0.05	1.37 ±0.05	p=0.04	4.61 ±0.18	4.65 ±0.21	5.90 ±0.23	p<0.01*
Cooking Self-efficacy[e]	1.15 ±0.05	1.30 ±0.04	1.38 ± 0.04	p<0.01	4.10 ±0.22	5.30 ±0.20	5.36 ±0.19	p<0.01*
Gardening Attitudes[f]	1.16 ±0.44	1.26 ±0.44	1.41 ±0.60	p<0.01	3.80 ±0.21	5.01 ±0.21	5.92 ±0.19	p<0.01*
Gardening Self-efficacy[g]	1.18 ±0.04	1.32 ±0.04	1.41 ±0.05	p<0.01	4.03 ±0.24	4.65 ±0.24	5.55 ±0.16	p<0.01*

[a]Covariates in analysis: age, gender, ethnicity, school, BMI
[h,i] Times per day
[j]Tertile 1: lowest involvement/attitudes/self-efficacy; Tertile 2: involvement/attitudes/self-efficacy; Tertile 3: involvement/attitudes/self-efficacy
[k]Tertiles expressed in mean ±standard error

DISCUSSION

These results indicate a positive correlation between cooking and gardening involvement, attitudes, and self-efficacy and fruit and vegetable intake in a low-income, primarily Hispanic youth population. These analyses demonstrate that children who are more involved in cooking and gardening consume more fruits and vegetables than those who are least involved. Similarly, children with the most positive cooking and gardening attitudes and self-efficacy compared with the lowest eat significantly more fruits and vegetables.

Exposure to a food is positively associated with preference for that food, and food preferences are largely shaped during childhood[37,84]. It has also been shown that children's preferences for vegetables predicts subsequent consumption of vegetables[40]. Because children typically dislike vegetables, it is important to expose children to vegetables and other healthful foods early on in life in an effort to improve their preferences, and ultimately influence their consumption of those foods[39]. Children's self-efficacy and attitudes towards fruits and vegetables also play a key role in their subsequent intake, so it is worthwhile to attempt to improve these metrics in children as a means to encourage them to consume more produce[9,86].

Children enjoy being directly involved in hands-on activities like cooking and gardening, and direct involvement and experiential learning in these activities has been shown to be superior to education alone in improving fruit and vegetable intake[23,61,79]. Hands-on activities promote a sense of ownership, and may create a new feeling of connection to healthful foods and identification with fruits and vegetables in ways that increases the child's likelihood of eating them[107]. In addition, children who are involved

in growing fruits and vegetables have a better understanding of how the foods they eat are associated with their health compared with children who are not directly involved[58]. This improved understanding coupled with hands-on learning experience may also play a role in increasing fruit and vegetable consumption.

Active participation in cooking and gardening may be key behaviors to getting children to adopt a healthier lifestyle by instilling a sense of pride in the fruits and vegetables that they have now been a part of the planting, growing, harvesting, and preparing of. Many cooking and gardening interventions yield positive results on improving dietary intake in youth, but it is important to determine which program components are eliciting the improvements as a means to tailor future interventions to successfully promote healthy eating in children and in high-risk, low SES children in particular. Thus, further analysis of specific components of these interventions is warranted.

Because low-income and minority youth are at increased risk for obesity and obesity-related diseases, it is especially important to improve the dietary intake of this population. Low-income, minority populations also have limited access to fresh fruits and vegetables, making it even more difficult for them to consume diets that are rich in these healthful foods[35]. Gardens are a cost-effective way to provide access to fresh fruits and vegetables, as it has been shown that for every $1 spent on creating a garden, a $6 yield of produce is returned[108]. Home meal preparation has also been shown to be associated with a decrease in per capita food expenses, making it an additional cost-effective and realistic strategy for improving dietary intake in low-income populations[100]. Therefore, exposure to cooking and gardening and increasing children's likelihood of adopting these

behaviors early in life is a step in the right direction towards improvement of their dietary intake both in childhood and as they grow into independent adults, especially in high-risk populations.

There are a few limitations of the present study to be addressed. First, this is a cross-sectional analysis using only baseline data, as the study is ongoing and changes as a result of the intervention were unable to be analyzed. Additionally, participants are between the ages of seven and twelve, so it is possible that they lack reading comprehension skills and were unable to answer questionnaire questions with complete accuracy. In order to combat this issue, bilingual interpreters were available to assist with reading comprehension. Lastly, determination of fruits and vegetables eaten came from a questionnaire asking about the number of times fruits and vegetables were eaten yesterday, leaving the possibility that the child's intake from the day before did not reflect their usual intake.

If children, especially high-risk children, adopt healthier habits early on in life, it is more likely that they will learn to maintain these habits throughout adolescence and adulthood, therefore reducing their likelihood of developing obesity and other obesity-related chronic diseases in adulthood that plague so many worldwide. This study directly relates cooking and gardening behaviors and determinants of behaviors to fruit and vegetable intake in a low-income, minority youth population and shows that greater involvement in cooking and gardening as well as improved attitudes towards and self-efficacy of cooking and gardening are associated with increased fruit and vegetable intake. Improving high-risk children's cooking and gardening experiences, attitudes, and self-efficacy through exposure to cooking and gardening activities may be an effective

way to improve their dietary intake in a feasible, cost-effective manner, that creates lasting healthy habits. Future research should focus on improving cooking and gardening experiences, attitudes, and self-efficacy as a means to increase fruit and vegetable intake in this high-risk population.

Chapter 5: Conclusion

The purpose of this research was to examine the associations between cooking and gardening behaviors and determinants of behavior with dietary intake and obesity in low-income, Hispanic youth. More specifically, this research addressed: 1) changes in cooking and gardening attitudes, self-efficacy, and motivation with changes in vegetable and dietary fiber intake and obesity parameters (BMI and waist circumference) as a result of the LA Sprouts randomized controlled intervention; 2) the baseline relationship between cooking involvement and parental support in food preparation with fruit and vegetable intake in participants of the Texas! Grow! Eat! Go! group-randomized controlled intervention; and 3) the baseline association between cooking and gardening behavior, attitudes, and self-efficacy and fruit and vegetable intake in participants of the TX Sprouts randomized controlled intervention. All three aims were analyzed using data from primarily low-income, Hispanic youth populations. The overall findings suggest that cooking and gardening behaviors and determinants of behavior are positively correlated with fruit and vegetable intake in this population.

Changes in cooking attitudes, cooking self-efficacy, and motivation to cook as well as changes in gardening attitudes and motivation to garden were all positively correlated with dietary fiber intake in participants of the LA Sprouts intervention. Analysis of the combination of cooking and gardening attitudes as well as motivation to cook and garden also yielded a positive correlation with dietary fiber intake in this population, however there were no significant associations between these determinants of behavior and vegetable intake, BMI, or waist circumference. Analysis of the impact of

child involvement in cooking and parental support in food preparation from the Texas! Grow! Eat! Go! intervention demonstrated similar results: children who are more involved in cooking at home as well as parents who are more supportive of their children in food preparation are exposed to more vegetables, have a greater preference for vegetables, and consume more fruits and vegetables. With participants in the TX Sprouts intervention, cooking involvement, gardening involvement, cooking attitudes, gardening attitudes, cooking self-efficacy, and gardening self-efficacy were all positively correlated with fruit and vegetable intake.

Overall, this research supports the idea that cooking and gardening are associated with improved dietary intake in low-income, high-risk youth. These findings are in alignment with much of the current literature that demonstrates the positive impact of cooking and gardening interventions in youth on fruit and vegetable preference and intake. However, much of the current research in the school-based gardening field focuses on the overall intervention's effects on dietary intake. One of the flaws with the current literature is the lack of standardized intervention components. Interventions typically contain cooking components and/or gardening components and/or nutrition education components, but there is a hole in the literature in directly relating which aspect(s) of these interventions is linked with improvements in dietary intake observed as a result of interventions. This is a necessary next step to figure out a realistic, cost-effective way of implementing these strategies on a larger scale as a means to address childhood obesity.

STEPS TO TAKE

It is essential to improve fruit vegetable intake in high-risk, low-income children. The first step is to make affordable fruits and vegetables available to these populations. Low-income populations often live in areas with limited access to fresh fruits and vegetables[35]. In addition to limited access, the prices of fruits and vegetables are increasing more rapidly than the cost of high-fat, high-sugar, and processed foods, which are the most inexpensive way to consume calories[109]. This makes it even more difficult to obtain and consume produce, especially in low SES populations. School gardens are a way to combat these barriers and provide access to produce to low-income families, as they give free accessibility to fresh fruits and vegetables. Although building a garden may seem costly at the outset, it has been shown that for every $1 invested in a garden, the return is $6 worth of produce, making this an extremely cost-effective strategy in the long run[108]. Building gardens is a feasible and economical strategy to improve availability and access to fresh fruits and vegetables to populations that lack access.

After making fruits and vegetables accessible to low-income populations, the next step is to encourage development of preferences for these healthful foods in children, as food preferences predict consumption and are formed during childhood[40,84]. Children enjoy cooking and gardening, and these activities are associated with increased preferences and intake[50]. Increasing children's preference for fruits and vegetables will allow them to form healthy habits early on that last into adulthood in order to decrease both childhood obesity as well as obesity later in life.

The final step in improving children's dietary intake is for them to learn how to cultivate a garden and prepare fresh fruits and vegetables from the garden in a way that is

simple, tasty, and appealing. Research suggests that childhood is the best time in life to learn skills that continue through adulthood, so teaching children cooking and gardening skills in a school setting at an early age will set them up with the tools they need to take these healthy habits with them as they grow up into independent adults[44].

Children enjoy hands-on learning, and it has been shown that being directly involved in cooking and gardening is more beneficial for improving fruit and vegetable intake than nutrition education alone[23,61,79]. Perhaps these hands-on activities promote children feeling a sense of pride in and ownership of formerly foreign fruits and vegetables. It is probable that children who feel this sense of connection with produce are more likely to prefer it and consume it than children who have not formed a similar connection.

Cooking at home is linked with a higher-quality diet quality and increased fruit and vegetable intake in dietary intake as well as decreased per capita food expenses, while gardening provides free access to fresh fruits and vegetables. Thus, cooking and gardening are feasible, cost-effective strategies to improve dietary intake in youth and create sustainable habits that can be continued into adulthood[46,100]. School-based cooking and gardening programs provide a platform to teach these skills to children and are effective in improving vegetable preference and intake. It is crucial to implement school cooking and gardening programs in schools and begin to involve children in these activities at a young age.

One of the main barriers to implementing these garden-based programs is persuading schoolteachers and administration that it is a valuable use of their limited time and funding. Teachers fear that taking time out of the school day will take away focus

from the core subjects that they are required to teach, however garden-based interventions are able to teach many topics that would be taught in the classroom anyway (i.e. parts of a plant, plant life cycle, etc.)[64]. Additionally, children may learn more effectively when learning topics in a hands-on fashion in the garden setting, implying that garden-based education will not detract focus from core subjects, and might actually improve their understanding[58,61]. Implementation of these programs into the school day would require successful mapping of core subjects into the topics taught in the garden, which a few interventions have successfully done.

FUTURE RESEARCH RECOMMENDATIONS

Further research is needed to determine which aspects of cooking and gardening interventions are exerting the most beneficial effects on dietary intake and how these parameters are changing as a result of the interventions. Specifically, it is important to determine how changes in cooking and gardening behaviors and determinants of behavior are changing over the course of the intervention, and how these changes are mediating subsequent changes in fruit and vegetable preference and consumption. When these interventions are scaled up, cooking and gardening components are often removed due to the perception that they require too much time and/or funding without providing a clear benefit[69]. It has been demonstrated that cooking and gardening are cost-effective strategies for improving dietary intake, and it is now necessary to establish a clear relationship between improvements in cooking and gardening behavior, determinants of behavior, and fruit and vegetable intake that take place over the course of garden-based

interventions so that the process of standardization of these programs and implementing them on a larger scale can begin.

MY FUTURE DIRECTIONS

This research has taught me how crucial it is to involve kids in the kitchen and with learning where foods come from. I did not have that experience growing up, and became obese in my adolescence. Learning to cook and understanding the importance of healthy eating and living is what transformed my health and helped me overcome obesity. I have created a website where I share healthy, easy, budget-friendly recipes that has now grown to reach more than one million viewers monthly across the world. I emphasize the importance of simple, healthy ingredients and provide step-by-step instructions for how to prepare each recipe with ease and in a cost-and-time-effective manner. My hope is to continue to reach people through my website to demonstrate how easy and delicious it can be to consume healthy food. This research has confirmed what I have experienced, and I believe setting children up with these tools to learn about and get involved in the preparing and growing of fruits and vegetables will have a positive influence on their lives and health in childhood and into adulthood.

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